DAIRY
REPORTS

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Contents

Acronyms

ADB	Asian Development Bank
AusAID	Australian Agency for International Development
CARE	Cooperative for Assistance and Relief Everywhere
CELDAC	Community Empowerment through Livestock Development and Credit
CIDA	Canadian International Development Agency
CO_2	carbon dioxide
CRCP	Consumer Rights Commission of Pakistan
DFID	Department for International Development
DM	dry matter
DP	digestible protein
ETPI	Environmental Technology Programme for Industry
Engro	Energy for Growth
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FCT	farm cooling tank
GDP	gross domestic product
HAACP	Hazard Analysis and Critical Control Point
KPK	Khyber Pakhtunkhwa (previously known as NWFP)
LDDB	Livestock and Dairy Development Board
NARC	National Agriculture and Research Centre
NGO	non-governmental organization
NWFP	North-West Frontier Province
PDDC	Pakistan Dairy Development Company
PIDE	Pakistan Institute of Development Economics
PSQCA	Pakistan Standards and Quality Control Authority
SMEDA	Small and Medium Enterprise Development Authority
TDN	total digestible nutrients
UHT	ultra-high temperature
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
UVAS	University of Veterinary and Animal Sciences

Preface

Over the last five decades the global dairy sector has seen substantive changes with major intensification, scaling-up and efficiency of production driven by demand from a growing human population and disposal incomes. This growth was achievable through the developments in animal breeding, nutrition, feed efficiency, animal health, housing and automation and supporting policies, strategies and organizations. Such changes are not however reflected across the whole dairy sector and while some developing countries have seen a major expansion in small-scale milk production, small-scale dairying in other countries has largely stagnated.

Dairying contributes positively to human wellbeing in a variety of different ways: nutrition through quality food products, income and employment, organic fertilizer as well as assets and savings. There are however negative aspects associated with dairying including its contribution to Green House Gases, pollution and waste disposal, food safety and human health, use of grains for feed, animal welfare and erosion of biodiversity. In order to inform the public and to make rational policy and investment decisions related to the dairy sector, it is essential to fully understand these complex interactions and their consequences.

This paper provides a review of these issues for the dairy sector of Pakistan. A tabular summary of main information is provided with the templates in Annex 13. We hope this paper will provide accurate and useful information to its readers and any feedback is welcome by the author and the Livestock Production Systems Branch (AGAS)[1] or to the Rural Infrastructure and Agro-Industries Division (AGS)[2] of the Food and Agriculture Organization of the United Nations (FAO).

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[1] For more information visit the website of the FAO Animal Production and Health Division at: http://www.fao.org/ag/aga.html or contact Olaf Thieme – Livestock Development Officer – Email: Olaf.Thieme@fao.org

[2] For more information visit the website of the FAO Rural Infrastructure and Agro-Industries Division at: http://www.fao.org/ag/ags/ or contact Anthony Bennett – Livestock Value Chains and Infrastructure Officer – Email: Anthony.Bennett@fao.org
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Executive summary

With a population of 160.9 million people in mid-2008, Pakistan is the sixth most populous country in the world, and has an estimated population growth rate of more than 2 percent per annum (Government of Pakistan, 2008). By 2030, 50 percent of the country's population is expected to live in cities (UNFPA, 2007).

Nearly 30 percent of household expenditure on food items is on milk and dairy products (ACR, 2006). Pakistan's annual milk production in 2007/2008 was approximately 42 million tonnes, making it one of the world's top milk producers (Government of Pakistan, 2009a).

Buffaloes and cows are the major milk producing animals, with 62 percent of milk produced by buffaloes and 34 percent by cows.[3] Approximately, 80 percent of the milk is produced in rural areas, with peri-urban areas accounting for 15 percent, and urban areas for 5 percent. Over the past ten years, milk production in Pakistan has risen by 36 percent (Government of Pakistan, various years). This gain in production is largely a result of increases in animal population rather than in animal productivity.

Two major sources of environmental pollution are peri-urban production systems and large-scale processing facilities. Waste management practices in these facilities contribute to unchecked emissions of greenhouse gases and contaminate water sources. There is little understanding or awareness of dairy-related environmental damage.

Pakistan's livestock feed industry is underdeveloped. Only about 0.20 million tonnes of feed are produced annually, against a total estimated requirement of 40 million tonnes.

The rural population engaged in livestock production is estimated at 30 to 35 million people, who derive 30 to 40 percent of their incomes from livestock (Government of Pakistan, 2005); 34 percent of these people are poor (PIDE, 2004). Over the past ten years, herds have become more fragmented, with 9.4 percent more buffaloes now kept in herds of only one to four animals. Women and girls play a primary role in management, and men are involved in marketing.

In the past three to five years, the government and donors have started investing in dairy development, with current projects valued at US$112 million. For the first time in the country's history, the government formulated a Livestock Policy in 2007. The formal dairy processing sector is the driving force behind the establishment of cold chains.

The two major types of marketing chain in the country are informal and formal chains, accounting for 97 and 3 percent, respectively, of total supply. The main differences between the two regard the sophistication of storage and handling infrastructure and practices.

Milk consumers in Pakistan are often faced with low-quality, adulterated milk. Lack of hygiene, adulteration with various agents, and absence of cold chains are primary contributors to this low quality.

The dairy sector presents opportunities for employment generation and poverty alleviation. A rapidly increasing population and high rates of urbanization are additional driving forces of the demand for fresh and processed milk and products.

The main hurdles faced by the sector are the piecemeal approach of government and donors to dairy development in general, and specific issues such as the primitive state of infrastructure and technology, the limited availability and high cost of inputs and related services, and minimal government support.

At the end of this report, key elements of a roadmap are recommended for the development of a successful dairy industry. These include an objective, guiding principles, and clearly defined roles for stakeholders.

[3] The remaining 3.61 percent of milk production is attributed to sheep, goats and camels.

Organization of the report

This report analyses the situation and development of the dairy sector in Pakistan based on literature review, statistical data and the information collected for the project "Assistance in up-scaling dairy development in Pakistan" (TCP/PAK/3004).

Chapter 1 gives a synopsis of the contribution to the economy of livestock, in general, and of milk in particular. It provides an overview of the dairy production systems in the country, and includes up-to-date data on livestock population, annual milk production and annual yields, along with imports of milk, and consumer preferences. It also presents a summary of the dairy sector's contribution to the national economy.

Chapter 2 discusses the environmental consequences of dairy production, and the level of understanding and awareness of these.

Chapter 3 outlines the importance of dairy production and its critical role in the economy of poor households. It highlights current development trends and programmes in the pipeline for the improvement of dairy production in Pakistan.

Chapter 4 reviews major food safety issues associated with the dairy supply chain in Pakistan. It also presents food safety legislation and regulation, enforcement, and the limitations in this area.

Chapter 5 identifies several public and private sector institutions and the institutional arrangements that serve different components of dairy development.

Chapter 6 provides an in-depth analysis of the dairy value chain, including production, bulking and cooling, processing and packaging, transport, and distribution and retailing.

Chapter 7 draws conclusions from the study and suggests recommendations based on the findings.

Chapter 1

Characterization of milk production systems

PAKISTAN'S MILK SECTOR AND MAJOR DAIRY PRODUCTION SYSTEMS

With a population of 160.9 million people in mid-2008, Pakistan is the sixth most populous country in the world, with an estimated population growth rate of more than 2 percent per annum (Government of Pakistan, 2008). In spite of its declining share in gross domestic product (GDP), agriculture is still the single largest sector, contributing 21 percent of GDP and employing 44 percent of the workforce. Despite a shift in employment in major sectors of the economy, agriculture also remains the dominant source of employment (Government of Pakistan, 2008). The livestock subsector accounts for 52 percent of agricultural and 11 percent of total GDP, and affects the livelihoods of 30 to 35 million people in rural areas (Government of Pakistan, 2008).

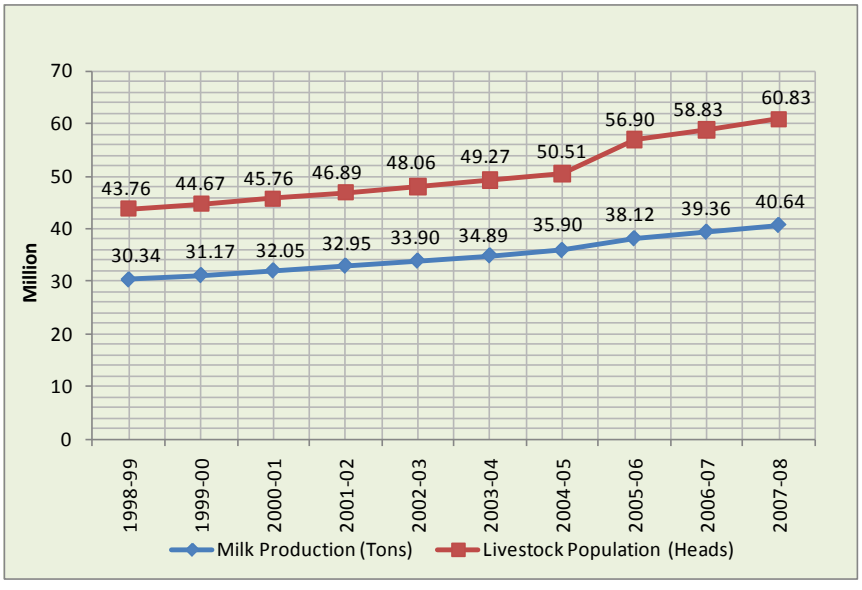
MILK'S CONTRIBUTION TO THE LIVESTOCK SECTOR

The dairy sector in Pakistan plays a significant role in the national economy and its value is more than that of the wheat and cotton sectors combined (FAO, 2006a). Estimated annual milk production in 2007/2008 was approximately 42.17 million tonnes, making Pakistan one of the world's top milk producers (FAOSTAT, 2010). Some 95 percent of all milk is produced from small-scale rural and peri-urban holdings with two to three milking animals (Social Sciences Institute NARC, 2003).

LIVESTOCK POPULATION

Comparison of the Livestock Census reports for 1996 and 2006 indicates that the populations of cattle and buffaloes increased by 44 and 34 percent, respectively (Government of Pakistan, 2009). Annex 1 compares the cattle and buffalo numbers among provinces. According to the 2006 census, Punjab has the largest buffalo population, with 64 percent of the total, followed by Sindh with 26 percent, Khyber Pakhtunkhwa (KPK) with 7 percent, and Baluchistan with only 1.2 percent. Punjab also has the largest cattle population, with 48 percent of the total, followed by Sindh with 23 percent, KPK with 20 percent, and Baluchistan with 7 percent. Annex 2 shows the total population of major milch animals in Pakistan; the population trend is presented in Figure 1.

FIGURE 1
Annual milk production and livestock population



Source: Agricultural Statistics of Pakistan.

ANNUAL MILK PRODUCTION

Buffaloes and cows are the major milk producing animals, with 62 percent of milk produced by buffaloes and 34 percent by cows.[4] Approximately 80 percent of milk is produced in rural areas, with peri-urban areas accounting for 15 percent, and urban areas for 5 percent. Punjab and Sindh are the major milk producing provinces, with annual production of 25.62 million and 9.35 million litres respectively. KPK produces an estimated 4.88 million litres per year, and Balochistan 0.81 million litres (PDDC, 2006). Annual milk production from 1998/1999 to 2007/2008 is presented in Figure 1, which shows that it increased by an average of 3.31 percent per year, or by a total of almost 34 percent.

Annual milk production from cows increased from 7.46 million tonnes in 1996 to 9.40 million tonnes in 2006, gaining 26 percent. Milk production from buffaloes increased from 14.96 million to 21.13 million tonnes, a 41 percent increase (Government of Pakistan, 1998 and 2009b).

This growth is directly proportional to the increase in human population, resulting in growing demand. The extra volumes are a result of increased herd size, and cannot be attributed to enhanced animal productivity, which has remained constant. According to Government of Pakistan (2009), the average annual yields of cows and buffaloes have remained approximately 453 and 904 kg respectively.

MILK PRODUCTION SYSTEMS[5]

Dairy farming in Pakistan is practised mainly by the private sector on various scales, in both urban and rural settings. However, the sector is generally characterized as fragmented and subsistence. With the exception of some peri-urban units, most dairy farming is practised in mixed crop-livestock systems.

Most research studies on dairy production systems in Pakistan classify farms on the basis of location and herd size, and identify four main systems of milk production: smallholder subsistence; smallholder market-oriented; rural commercial; and peri-urban. These are explained in the following subsections.

Smallholder subsistence production system[6]

Smallholders in rural areas who lack access to a substantial milk market produce milk to meet family requirements at minimal cost. The average subsistence unit consists of about three buffaloes. Average milk yields per animal are 3 litres/day. The main inputs into these households' dairy production are often non-cash resources, such as family-owned land and labour. Some 70 percent of smallholder milk producers fall into this category (Raja, 2003). As local tradition prohibits the selling of milk, most of these farmers do not market milk, even when surplus is available.

Smallholder market-oriented production system

These farmers have satisfactory access to a milk market, encouraging them to produce in excess of family requirements. The typical production unit in this system is family-owned, and consists of five buffaloes: three adult females, one or two female followers, and a male calf. Milk is sold through various channels, including direct sales to retail shops in the nearest city, and sales to intermediaries or the procurement agents of dairy processing corporations.

Rural commercial production system

Recent developments in the dairy industry have encouraged some progressive farmers to invest in milk production. However, these farms still represent less than 1 percent of dairy farms across the country. Average milk yields per animal are 10 litres/day. Potential channels for the marketing of milk in this system are the same as those in the smallholder market-oriented system.

Peri-urban production system

Peri-urban production occurs in commercial-scale units located on the peripheries of major urban centres. These maintain herd sizes ranging from ten to 200 head, and averaging 50 animals – 90 percent buffaloes and 10 percent cows (FAO, 2006a).

These units employ family and hired labour, the latter being paid at local urban rates. Milk is delivered to the market twice a day. Major overheads in this system include hired labour costs, animal shelter, veterinary care, feed, water and electricity bills, and milk transport. Milk is sold either through direct sale to retail shops in the city or under annual contracts to intermediaries.

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[4] Agricultural Statistics of Pakistan 2007/2008; the remaining 3.61 percent of production is attributed to sheep, goats and camels.

[5] This section is based on FAO, 2006a.

[6] This subsection is based on FAO, 2006a.

Some peri-urban production is carried out by small farms, especially in smaller urban centres. The farms produce milk primarily to satisfy family needs, and surplus is marketed.

The four different production systems are summarized in Annex 3.

PROFILE OF DAIRY HERDS

Table 1 shows the distribution of Pakistan's total cattle and buffalo herd (the principal dairy animals in the country). The data show that most households (more than 84 percent) raising cattle and buffaloes are smallholders with fewer than five animals.

TABLE 1
Distribution of milk producers, by herd size

Herd size	% of households
1–4	84
5–10	14
> 10	2

Source: Government of Pakistan, 2009.

TRENDS IN PRODUCTION SYSTEMS

To understand the trends in production systems, the percentages of total animals in each herd size in 1996 were compared with the percentages in 2006 (Figure 2 and Annex 4).

A clear trend was observed, showing increased fragmentation. Experts attribute this to the increasing cost of obtaining and maintaining a herd. This means that a greater percentage of total dairy animals are now kept in smaller herds of one to four animals, while fewer animals are kept in medium-sized and large herds of more than five head.

Figure 2 shows that 9.4 percent more buffaloes were kept in herds of one to four head in 2006 than in 1996, while 8 percent fewer buffaloes and 9.2 percent fewer cows were kept in herds of five to ten head, and 1.4 percent fewer buffaloes and 1.5 percent fewer cows in herds of more than ten.

IMPORTS[7]

Pakistan's population has increased from 65 to 161 million over the past three decades, and is forecast to grow to 234 million by 2025 (ACR, 2006). Consequently, the country has been facing a domestic deficit in milk supply. According to an FAO-sponsored study (Social Science Institute NARC, 2003), in 2003, the gap between production and consumption was estimated at 3.5 million tonnes (10 percent). The study forecast that this gap will widen considerably, reaching an estimated deficit of 55.48 million tonnes in 2020.

For the past several years, milk has been imported to bridge this supply gap. Figure 3 and Annex 5 show the imports of milk powder from 1998/1999 to 2007/2008.

CONSUMER PREFERENCES[8]

Nearly 30 percent of household expenditure on food items is on milk and dairy products (ACR, 2006). A major proportion of milk is consumed in tea, which is a common drink, so milk is demanded by every household in the country.

Consumers in Pakistan can be categorized as rural or urban. Major differences between the two are in their access to milk production, purchasing power, and taste preferences, while both share a very high preference for liquid milk, with some milk by-products such as *lassi*[9] and yoghurt also in demand. Owing to its fat content, density and colour, buffalo milk is usually preferred, so is more expensive than cow's milk. The average prices in urban areas are US$0.52/litre for fresh buffalo milk, and US$0.47/litre for fresh cow's milk (according to a rapid market survey).[10]

Provincially, annual per capita consumption is highest in Sindh, at 246 kg. In Punjab it is about 132 kg, in KPK about 86 kg, and in Balochistan about 108 kg.

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[7] All currency rates/values in the report are based on an exchange rate of PRs 80 = US$1.

[8] This section is based FAO, 2006a.

[9] Traditional drink made by blending yogurt with water and spices

[10] All currency rates/values in the report are based on an exchange rate of PRs 80 = US$1.

FIGURE 2
Changes in buffalo herd sizes, 1996 to 2006

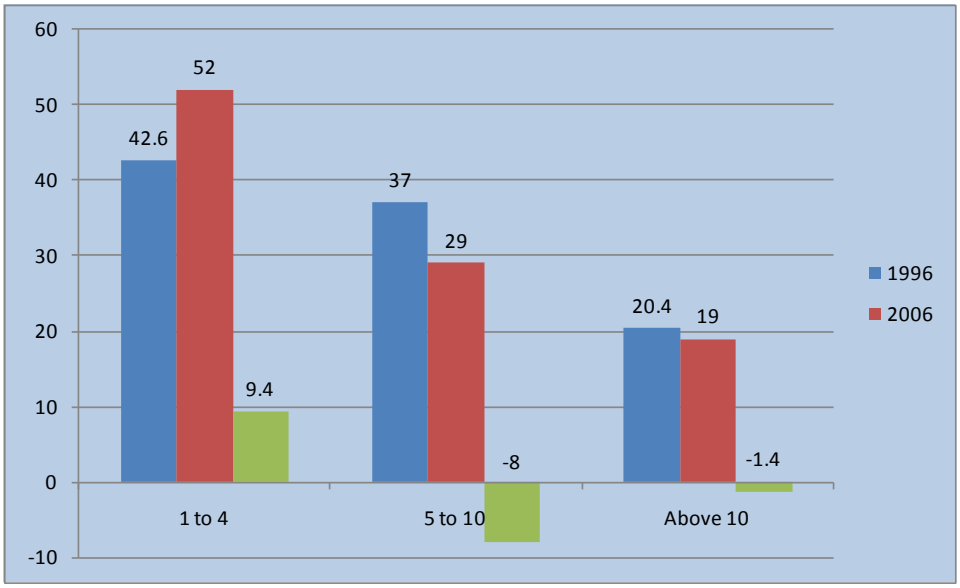
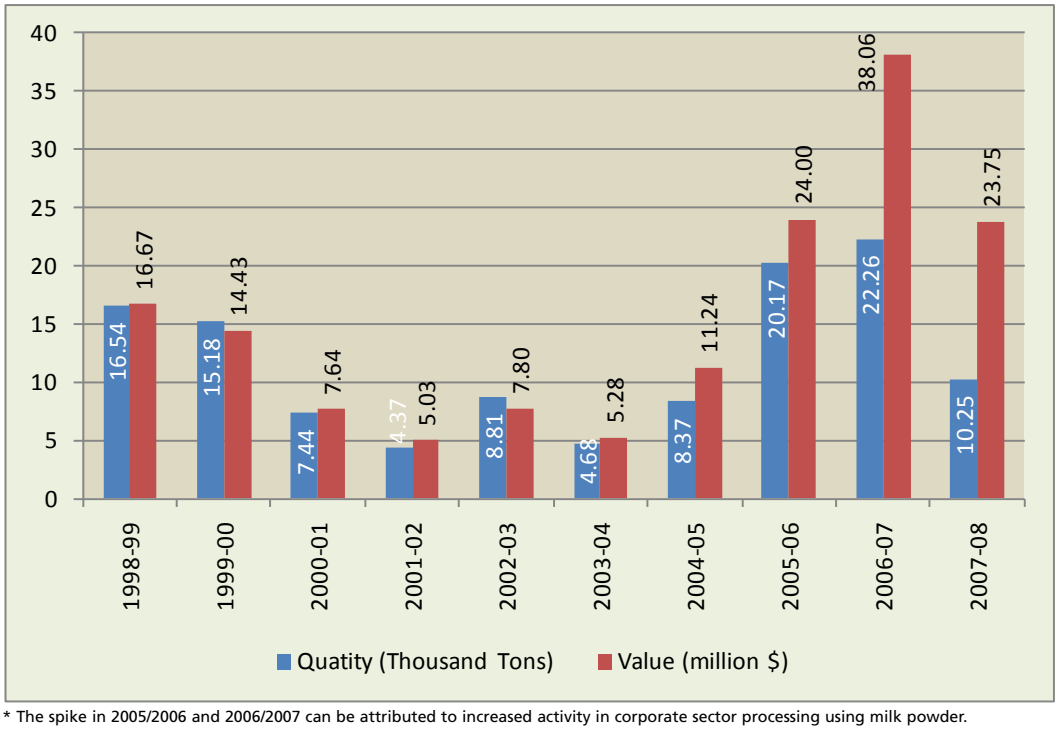


FIGURE 3
Milk imports, 1998 to 2008



* The spike in 2005/2006 and 2006/2007 can be attributed to increased activity in corporate sector processing using milk powder.

Chapter 2

Dairy production and the environment

Livestock activities have a significant impact on virtually all aspects of the environment, including air and climate change, land and soil, water and biodiversity. The impact may be direct, such as the concentration of solid waste and pollutants, which emits nutrients, organic matter, pathogens and drug residues into subsoil water, rivers and lakes, or indirect, in the form of competition for natural resources. Animals and their waste emit greenhouse gases such as carbon dioxide (CO_2), nitrous oxide and methane, which if not managed properly, contribute to climate change. Land-use changes resulting from increased demand for feed grains and grazing land also put pressure on the environment.

INDICATORS OF ENVIRONMENTAL DEGRADATION

The two major sources of environmental degradation in Pakistan's dairy sector are production systems and large-scale processing facilities.

Production systems

With approximately 35 percent of the country's population living in urban areas, there has been rapid growth in peri-urban dairy farming. These farms operate under intensive production conditions, with large number of animals kept in small compounds[11]. There is a total lack of proper waste management practices, and animal waste is often disposed of in major water bodies. This not only contaminates public drinking-water, but also leads to unchecked methane emissions.

Overgrazing is another serious threat to the environment. In Pakistan, forage/grazing provides approximately 38 percent of animal feed. The average annual gain in milk production (3.61 percent) is largely a result of increases in animal population, rather than animal productivity. Larger animal numbers translate into greater requirements for feed, leading to environmental degradation, while most laws on grazing are ignored and not enforced.

Processing facilities

In 2006, at least nine processing plants were operational, with average monthly capacities ranging from 0.1 to 1.4 million litres (PDDC, 2006). These plants generate liquid waste (wastewater from washing and cleaning operations), solid waste (paper and board for packaging), air emissions (burning of waste, hydrogen peroxide, and milk powder dust), soil pollution and noise. Of these, wastewater is the greatest pollutant. A typical dairy unit generates between 5.5 and 30 m^3 of wastewater for every cubic metre of milk processed (ETPI, 2000). Annex 6 gives a detailed breakdown of the sources of this wastewater.

AWARENESS AND UNDERSTANDING OF ENVIRONMENTAL CONSEQUENCES

Worldwide, among producers, consumers and policy-makers alike, there is a general lack of understanding about the nature and extent of livestock's impact on the environment. Livestock-environment interactions are not easily understood. They are broad and complex, and many of the impacts are indirect and not obvious, so it is easy to underestimate livestock's impacts on land and land use, climate change, water and biodiversity (FAO, 2006b). This leads to an absence of policy framework conducive to more environmentally benign practices; where such a framework does exist, it is rudimentary at best.

The situation in Pakistan is no different, as demonstrated by the recent (2007) Livestock Policy's failure to mention environment. Awareness and understanding of the environmental consequences of dairying are extremely limited in all sectors, including the government, donors and the private sector. What awareness there is tends to be superficial, and focuses on the more obvious contamination, such as flies and odour, rather than the serious threats of land degradation, water pollution, biodiversity erosion and global climate change.

[11] The internationally known Landhi Cattle Colony in Karachi is an example.

RESEARCH

No resources are committed to research on and discussion of the environmental effects of the dairy sector, although there has been some recent interest in the development of biogas[12]. However, these efforts focus on easing women's burden by providing fuel, rather than on the environmental consequences of dairy waste.

Landhi Cattle Colony in Karachi has shown interest in generating biogas from animal waste. This is driven partially by concerns about the environmental effects of methane emissions and partially by an interest in commercial energy generation, as a by-product. However, so far, all attempts have failed, owing to ownership conflicts between the private sector and the government and to a shortage of technological expertise.

FEED SOURCES

Two types of feeding practice prevail in Pakistan's dairy production systems:

- In *rural households,* animals are closely integrated within rural subsistence economies and are fed grown fodders in the form of residuals and crops used as cut-and-carry livestock feed.
- In *intensive and semi-intensive dairy farming* around major urban markets, where mainly buffaloes are kept (but with increasing numbers of cattle cross-breeds), animals are fed on crop residues and other agro-industrial by-products. The use of green fodder depends on its economic availability.

More than half of animal feed is obtained from fodder and crop residues, one-third from grazing on rangelands, wastelands, canal banks and roadsides, and the rest from crops and their by-products.

Fodder availability is the major limiting factor for milk production. Fodder crops cover 16 to 19 percent of the country's total cropped area. With minor fluctuations, this area decreased from 2.6 million ha in 1976/1977, to 2.45 million ha in 2005/2006, or about 1.6 percent per annum, according to the Ministry of Food, Agriculture and Livestock's Planning Cell. This decline is likely to increase in the future, as cash crops such as wheat and sugar cane obtain higher prices and have more economic potential.

Overall, Pakistan faces a deficit of feed sources, as demonstrated by shortages of 57.24 million tonnes of dry matter (DM), 28.62 million tonnes of total digestible nutrients (TDN), and 1.76 million tonnes of digestible protein (DP). Green fodder shortages occur between May/June and December/January, encouraging recent small-scale efforts to grow multi-cut fodder crops such as sorghum-Sudan grass hybrids (*Sorghum bicolor* and *S. bicolor subsp. drummondii*), lucerne, mixtures of cereals and legumes, and mott grass.

The country's formulated feed industry is underdeveloped. Compared with an estimated annual demand of 40 million tonnes, only about 0.20 million tonnes is produced. This feed is also unaffordable for smallholders, and used by only market-oriented dairies, where it is available.

GENETIC DIVERSITY

Pakistan has 31.8 million cattle and 29 million buffaloes (Government of Pakistan, 2009), producing 14 million and 26 million tonnes of milk, respectively (Ministry of Food, Agriculture and Livestock (2009).

TABLE 2
Contributions of different feed sources for dairy animals in Pakistan

Source	Contribution (%)
Fodder and crop residues	51
Forage/grazing	38
Cereal by-products	06
Post-harvest grazing	03
Oilcakes, meals, animal protein	02

[12] Winrock International is implementing a domestic biogas programme.

Buffaloes

Buffaloes are the major milk producing animals in Pakistan, representing about 48 percent of the total dairy herd and providing 62 percent of total milk production (Government of Pakistan, 2008). The three principal breeds are Nili, found mostly in Punjab province, and Ravi and Kundi, found mostly in Sindh.

Due to indiscriminate breeding, most of the herd is "non-descript". Little is done to research or maintain the purity of buffalo breeds. The government has undertaken buffalo breeding projects at livestock research centres, but farmers are largely excluded from the results of this research, thereby limiting its benefits. Recently, there has been interest in improving understanding of the complex issues involved in buffalo reproduction.

Cattle

The cattle population is slightly larger than that of buffaloes, but cows produce on average only about 55 percent of the yield of buffaloes. All Pakistan's indigenous cattle are Zebu (humped type, *Bos indicus*). There are 15 recognized breeds in the country, of which Red Sindhi and Sahiwal are well known internationally as tropical dairy cattle breeds. Cattle have traditionally been bred to produce bullocks for ploughing and on-farm operations.

A sizable population of cattle cross-breeds have recently emerged, and now represent 13 percent of Pakistan's total cattle population. Pure breeds account for 43 percent, and non-descript for 44 percent (Khan *et al.,* 2008). Breeding policy allows the cross-breeding of non-descript cattle with Holstein, Friesian and Jersey breeds, with the desired level of exotic inheritance being between 50 and 75 percent.

The productivity of dairy cattle cross-breeds is far higher than that of local non-descript or pure breeds, with longer lactation periods, higher milk production per lactation, and shorter calving intervals. These advantages make cross-bred cattle highly preferred for intensive and semi-intensive dairy farming systems. An average quality cross-bred animal costs almost 40 percent more than an average buffalo. Semen for cross-breeding programmes is imported from countries such as the United States of America, Germany and Australia by private sector firms.

Chapter 3
Dairy and livelihoods

The rural population engaged in livestock production is estimated at 30 to 35 million people, who derive 30 to 40 percent of their incomes from livestock (Government of Pakistan, 2005). In 2005/2006, 10 percent of rural and 6 percent of urban households derived their entire incomes from livestock products (Government of Pakistan, 2006). Of the households earning income from livestock, 34 percent are poor (PIDE, 2004).

Little research has been done on dairy's contribution to households. Available statistics are either aggregated under total livestock contribution or factored in as contribution of the overall agriculture sector.

However, dairy production contributes significantly to the incomes of small households, as shown in Table 3.

FINANCIAL CONTRIBUTION

Table 3 shows that milk contributes a total of US$549 million per month to the livelihoods of households with one to four animals each, US$301 million per month to those with five to ten animals, and US$225 million per month to those with more than ten animals. The total monthly contribution of dairying to incomes is estimated at more than US$1 billion[13].

More than half (51 percent) of total revenues from dairy sales are accrued by smallholders owning one to four animals, with each of these households generating a monthly income of US$60 to $240.

IN-KIND CONTRIBUTION

According to industry estimates, approximately 60 percent of the milk produced by smallholders is consumed at home, and the remaining 40 percent is marketed. Of the total value in Table 3, 60 percent can therefore be considered as a direct contribution to households' food security.

TABLE 3
Monthly income from dairy

Herd size	No. of animals[a]	No. of lactating animals[b]	Average monthly yield (litres)[c]	Average price (US$/litre)[d]	Monthly national income from lactating animals (US$)	Monthly household income per lactating animal (US$)	Monthly household income (US$)		Diary income as % of total household income
							Min. (US$)	Max. (US$)	
1–4	13 677 787	9 164 117	150	0.40	549 847 037	60	60	240	51%
5–10	7 501 887	5 026 264	150	0.40	301 575 857	60	300	600	28%
> 10	5 613 334	3 760 934	150	0.40	225 656 027	60	660	-	21%

[a] Government of Pakistan, 2009: Table 11.
[b] Assuming that 67 percent of the herd is lactating at any given time.
[c] Ministry of Food Agriculture and Livestock, no date
[d] Based on an average price of US$0.40/litre; the price of buffalo milk ranges from US$0.23 to $0.56/litre.

Source: Calculated from information provided by the sector.

TABLE 4
Values of herds

Herd size (head)	Price per animal (US$)	Minimum herd value (US$)	Maximum herd value (US$)
1 – 4	525	525	2 100
5 – 10	525	2 625	5 250
> 10	525	5 250	-

[13] Based on gross revenues, without taking production cost into consideration.

Poor people also consider their dairy animals to be cashable assets for times of emergency. Table 4 gives estimates of the total values of herds of different size, assuming an average price of US$525/head, based on average prices of US$400 for a cow and US$650 for a buffalo.

According to these data, a smallholder's herd ranges in value from US$525 to $2 100, and a herd of five to ten animals ranges from US$2 625 to $5 250.

DAIRY PRODUCTION AND RURAL DEVELOPMENT

Despite the limited attention paid to dairying in the past, both public and private sector funding is now becoming increasingly available in the belief that enhanced dairy production will improve the incomes of marginalized poor farmers, including women.

CURRENT DEVELOPMENT TRENDS

The government formulated Pakistan's first-ever Livestock Policy in 2007. The policy puts considerable focus on dairy sector development.

Processing corporations have made significant investments in the establishment of cold chains in remote dairy producing areas, and are developing quality-based procurement. Realizing the positive impact that development funding can have on strengthening the supply chain for raw milk, the private sector has recently started to implement projects under public-private partnership modalities[14]. These projects aim to enhance productivity and organize farmers for milk collection and marketing, while providing them with information and access to market channels.

Donor and government projects are a result of the realization that projects in dairy development reach large number of beneficiaries, including women, and show relatively quick results. The rapidly increasing demand and high margins are additional driving forces behind private sector investments.

ONGOING DEVELOPMENT PROGRAMMES

Many ongoing government and donor development programmes focus on smallholders and work to provide extension services, increase farm-level productivity, and develop producer access to markets. Programmes are implemented in collaboration with local non-governmental organizations (NGOs) and often have poverty elimination and community development as their main objectives.

Large dairy development projects amounting to a total of US$50.50 million are being funded by CIDA, the Australian Agency for International Development (AusAID), USAID, the Department for International Development (DFID) and the European Union (EU). In addition, the Government of Pakistan has invested in five mega-projects worth a total of US$61.5 million (Annex 7).

The government has also started giving incentives for development of the dairy sector. These include (Government of Pakistan, 2008) regulatory measures for imports of high-yielding animals, semen and embryos for cross-breeding; duty-free imports of veterinary dairy and livestock machinery/equipment (not manufactured locally); zero customs duty on imports of cooling system and milk processing machinery/equipment (not manufactured locally); and exemption from retail sales tax for processed products.

All of these dairy development programmes are recent, with the first starting in 2007. It is therefore too early to ascertain their impact, although some general conclusions can be drawn:

- *Public programmes:* These are facing problems with farmer outreach. In addition, the sustainability of their impacts can be affected by the short-term, project-based approach to initiatives.
- *Private programmes*, including donor-funded projects: These have started to look at the entire value chain, but are often designed and implemented in short time spans of two to three years. The UNDP-implemented CELDAC project, which is in its third year, has shown good progress and results, having trained more than 3 000 local women extension workers in 1 450 villages of 14 Punjab districts.

[14] For example, the Community Empowerment through Livestock Development and Credit (CELDAC) project implemented by the United Nations Development Programme (UNDP) with Nestle and Energy for Growth (Engro); a Canadian International Development Agency (CIDA)-funded project implemented by Haleeb; and a United States Agency for International Development (USAID)-funded project by the Cooperative for Assistance and Relief Everywhere (CARE) and Engro.

EMPLOYMENT IN THE DAIRY SECTOR

Dairying in Pakistan is labour-intensive and engages a large number of agents along the value chain, including 6.8 million farmers, and thousands of milk collectors, transporters, processors, distributors and retailers. The input and services industry also provides employment to a large number of workers, including in the feed and veterinary supply chain.

However, it is difficult to quantify employment figures for the dairy sector based on the available data. The two official sources of information, the Household Integrated Economic Survey (Government of Pakistan, 2006) and the Labour Force Survey, consolidate numbers for agriculture, forestry and fishery together. Considering the wide breadth of the value chain, a detailed study is required to quantify the various on- and off-farm livelihoods.

OPPORTUNITIES FOR IMPROVING DAIRY LIVELIHOODS

Pakistan has the highest level of urbanization in South Asia; by 2030, 50 percent of its population is expected to live in cities (UNFPA, 2007). This rapid urbanization, coupled with population increase, is expected to lead to higher demand for dairy and related goods and services. Increasing demand is encouraging intensive farming, and leading to a rise in the demand for prepared feed and veterinary services. These businesses can be sources of employment.

According to an industry estimate, there are only 5 000 veterinarians in Pakistan, serving the entire livestock population, including 53.9 million dairy animals. This shows that the veterinary sector is under-resourced, and presents livelihood opportunities for newly trained professionals, including extension workers, para-veterinarians and veterinarians.

With development of the corporate processing sector, there are increasing opportunities for graduates specializing in dairy technology and livestock production. This situation has already been capitalized on by the University of Veterinary and Animal Sciences (UVAS), in Lahore, where the country's first dairy technology centre was established in 2007.

Challenges facing the dairy sector are presented in Chapter 7.

Chapter 4
Safety of milk and dairy products

The perishable nature of milk, the long distances between production and consumption sites, inefficient marketing infrastructure, and the number of intermediaries involved in hauling milk through the marketing chain are all factors that can lead to the adulteration or contamination of milk.

QUALITY CONTROL

Lack of hygiene, adulteration by various agents, and absence of a cold chain are the primary contributors to low-quality milk.

Hygiene and adulteration

The dairy industry is highly unregulated in Pakistan, and the marketing chain is exclusively in the private sector. In the absence of checks and balances, adulteration is rampant, as each agent in the marketing chain seeks to maximize profits.

Farmers

Due to lack of proper management practices, national-level milk yields are only 1 195 litres/lactation for cows and 1 800 litres for buffaloes (SMEDA, 2000). To boost production, some farmers use oxytocin injections, which are especially common among market-oriented dairies.

Another widespread practice among farmers is the adding of water (often contaminated) to milk to increase its volumes.

Intermediaries

Dodhis or intermediaries are seen as being responsible for most adulteration in the marketing chain. This could be because dodhis transport milk over long distances, often in extreme weather conditions. Agents in the marketing chain in Pakistan rarely have access to cold storage facilities, and a major portion of milk is lost. According to an Asian Development Bank (ADB) report (Malik and Luijkx, 2004), milk losses due to the lack of cold storage are estimated at about 15 to 20 percent of total milk production in some areas.

One of the basic methods dodhis use to prevent heat spoilage is to add ice to the milk, generally 1 kg of ice for every 10 kg of milk, during the summer. The ice is often made from dirty water, which can cause health problems. To prevent spoilage during transit, intermediaries are also known to add bacterial inhibitors, such as penicillin. Other adulterants, including washing powder and maize flour, are used to enhance volume and whiteness.

Adulterants believed to be commonly used by intermediaries are listed in Annex 8.

FOOD SAFETY LEGISLATION AND REGULATION

Pakistan does not have an integrated legal framework for food safety, but rather a set of food safety laws. These national standards are not aligned with international standards for quality in dairy products.

The laws that specifically deal with food safety are (Siraj, undated):

i. Pure Food Ordinance, 1960;
ii. Pakistan Hotels and Restaurant Act, 1976;
iii. Pakistan Standards and Quality Control Authority (PSQCA) Act, 1996.

A brief overview of these laws is given in Annex 9.

Existing laws already have the capacity to achieve at least a minimum level of food safety. However, they are very poorly enforced.

Limitations in food safety legislation

Current food laws are inadequate for meeting market demands. The Health Department and local governments are both responsible for implementing food laws, but their implementation capacity at the grassroots level is extremely limited. Areas of the dairy marketing chain where safety regulation is particularly necessary are hygiene, handling and quality, in both the formal and informal sectors.

Additives

Existing food regulations do not explicitly prohibit or limit the use of harmful preservatives, including bacteria inhibitors such as penicillin and formalin, and other substances such as urea, sugar and glucose. The use of oxytocin is not prohibited by law.

Processing

No regulation obligates dairy processing corporations to provide hygienic milk. In this regard, policy formulators should consider:

- establishing criteria to ensure good-quality milk, including tests of its organoleptic and technical/chemical characteristics, and of other raw material, such as packaging;
- ensuring control of food hazards by implementing standards similar to those in the Hazard Analysis and Critical Control Point (HACCP) and similar systems;
- establishing and designing facilities;
- labelling ingredients and shelf-life on packaging;
- Use of melamine (which is legal under current PSQCA standards)

MEASURES BEING TAKEN

Dairy development programmes funded by international donors are now paying attention to hygienic and clean milk marketing, for example, the USAID-funded Empower Pakistan: Smallholder Dairy Development Project. These projects seek to ensure the production of hygienic milk by providing farmer education and grants for the establishment of cold chain systems. However, little is being done to improve legislation or enhance enforcement measures for existing laws.

Chapter 5
Dairy institutions

Most of the institutions supporting the dairy sector in Pakistan are in the public sector, but some private corporations have also contributed significantly to sector development and modernization.

PUBLIC SECTOR INSTITUTIONS

Dairy development institutions in the public sector fall into two categories: government ministries and departments; and public sector companies.

Government ministries and departments

The primary government institutions are the Ministry of Livestock and Dairy Development, provincial departments of livestock and dairy development, universities and other departments providing supporting services.

Ministry of Livestock and Dairy Development

This federal-level ministry is responsible for overall policy formulation, economic coordination and planning for livestock[15]. The ministry has several specialist departments with offices in all provinces. These include:

- the Animal Quarantine Department;
- the Agricultural and Livestock Products Marketing and Grading Department;
- national veterinary laboratories.

The ministry is headed by a Minister (elected representative) and managed by a Federal Secretary (government-appointed official).

Provincial departments of livestock and dairy development

Each province has a Department of Livestock and Dairy Development, headed by a Provincial Secretary assisted by Director-Generals as heads of internal departments. The provincial department is responsible for overall policy implementation, veterinary services, and coordination with donors.

Ministry of Industries and Production

In recent years, this ministry has supported the dairy sector by implementing key projects, among the most prominent of which was setting up the Pakistan Dairy Development Company (PDDC). The ministry's Small and Medium Enterprise Development Authority (SMEDA) undertakes projects in dairy development as part of its portfolio.

Universities

Pakistan has five major agricultural universities[16] and various agricultural colleges with some focus on livestock, but UVAS in Lahore is the only institute of learning specifically dedicated to this sector. The university also houses a dairy animal training and research centre, set up in 2006/2007 and offering a B.Sc. degree course in dairy technology, a four-year graduate programme, and a M.Phil./Ph.D. course in dairy technology for post-graduates.

Other government departments

Various other government departments are indirectly engaged in providing support to the dairy sector. These include the Pakistan Standards and Quality Control Authority (PSQCA), responsible for setting standards for food safety, including milk and by-products.

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[15] Livestock and dairy development was managed by the Ministry of Food, Agriculture and Livestock until 2008, when a separate ministry was established.

[16] There is at least one agricultural university in each province.

Public sector companies

These are semi-autonomous bodies registered under Section 42 of the Companies Ordinance 1984. Most were set up with seed funding from the government or international aid agencies, and members of their boards include sitting government officials. Among the prominent institutions contributing to dairy development are PDDC, the Livestock and Dairy Development Board (LDDB), SMEDA and a network of nine rural support programmes.

STRENGTHS AND WEAKNESSES OF THE PUBLIC SECTOR

Strengths

The provincial and federal governments play a key role in policy-making to guide strategic development of the dairy sector. The government and its associated semi-autonomous bodies have nationwide coverage at the local level.

Weaknesses

The following inherent weaknesses prevent public sector programmes from delivering their mandates effectively:

- *Weak outreach capacity*: The government's infrastructure is extensive, with local presence at the district and union council levels. However, outreach capacity does not match this infrastructure because of financial and human resource constraints, such as chronic staff absenteeism, lack of transport for extension workers to reach producers, and poor provision of veterinary drugs and vaccines.
- *Lack of coordination*: There is little coordination among the many government departments and agencies. For instance, because Pakistan's experience in local government decentralization is relatively new[17], the coordination mechanisms between provincial and local government have been disrupted, hampering service delivery at the local level. The roles of different government departments are sometimes not clear; for example, similar projects have been implemented by the Ministry of Food, Agriculture and Livestock and the Ministry of Industries and Production.
- *Reliance on donors:* Currently, government projects rely heavily on donor funding, so many are short-lived and address limited short-term objectives instead of contributing to long-term development issues such as breeding, strengthening of government extension services, or development of local input industries. This also leaves government with little control over project design and implementation. In addition, as different donors have similar priorities, many projects have overlapping roles, creating inefficiencies in implementation.

PRIVATE SECTOR CORPORATIONS

Market competition has encouraged the top three processors – Nestle, Engro Foods and Chaudhry Dairies – to establish widespread milk collection networks for procuring milk from smallholders in the country's remotest milk producing areas. Infrastructure consists of milk cooling tanks and refrigerated transport. These companies also provide their suppliers with management, production and hygiene advice.

Several private sector companies provide support services, mainly cold chain equipment (from Unitech), feed (AkzoNobel, formerly ICI), and veterinary drugs (from Ghazi Brothers).

STRENGTHS AND WEAKNESSES OF THE PRIVATE SECTOR

The private sector has modernized the milk marketing chain, and paved the way to supplying milk in a rapidly urbanizing country. However, one of its weaknesses is its lack of attention to and investment in low-cost technologies for the production of safe yet affordable products, such as pasteurized milk.

Consumer preference for fresh milk, fragmented and subsistence farming, and the exorbitant capital investments required for cooling infrastructure also hamper the growth of these companies.

NECESSARY SUPPORT SERVICES

Compared with other developing countries, Pakistan has strong infrastructure, and its dairy sector has numerous options for support and inputs. However, the following gaps exist:

- There is a need to *improve the provision of input services*, such as by enhancing the local production of feed, vaccines and machinery. For instance, the national production capacity for bacterial and viral veterinary vaccines

[17] Provincial government was decentralized to the district level in 2001.

is 65.57 million doses, covering only 8 percent of the 833.41 million doses required (Government of Pakistan Planning Commission for 2007/2008).

- There is also a need for *cost-effective technologies* for use in the supply chain, including insulated storage tanks instead of the currently used diesel or electric power generators.
- *Breed improvement* programmes to enhance productivity are required. Currently, increases in production are mostly the result increased animal numbers rather than improved productivity per animal. This leads to higher input costs, and puts pressure on the environment when supplying food and water for an ever-increasing herd. Larger herds also generate more emissions and negative impacts on the environment.

Chapter 6
Analysis of the dairy value chain

As fresh, raw milk[18] is the preferred consumer product in Pakistan, the consultants for this study selected it as the product for their analysis of the dairy value chain.

PRODUCTION SYSTEM AND STRUCTURE

The percentages of small-, medium- and large-scale producers in total producer and animal numbers are given in Table 5.

More than 80 percent of dairy producers are smallholders, who raise 51 percent the animals (cattle and buffaloes) in the country; about 3 percent are large-scale producers, with 21 percent of total animals (cattle and buffaloes); and about 14 percent are medium-sized, with 28 percent of the national herd.

People/genders involved in dairy activities

The production unit in *smallholder subsistence and smallholder market-oriented production systems* is family-owned and operated using non-cash resources such as family-owned land and labour. *Peri-urban production systems* employ family and hired labour, the latter being paid at local urban rates. In both of these systems, women are involved in major management activities such as feeding, watering and housing, while men are involved in marketing. Table 6 ranks the participation of men and women in major milk production activities.

TABLE 5
Contributions of different production scales

Herd size	% of total producers	% of total animals
1–4	83	51
5–10	14	28
> 10	3	21

Source: Government of Pakistan, 2009.

TABLE 6
Involvement in dairy production activities

Ranking			Involvement by community/household member	
0 to 1			Minimum participation	
1.1 to 2			Some participation	
2.1 to 3			Maximum participation	
Activity	**Men**	**Women**	**Girls**	**Boys**
Feeding	0.70	2.53	1.50	0.60
Collecting fodder for animals	0.60	2.70	0.50	0.40
Shed management	0.70	2.75	0.95	0.45
Marketing of products	2	1	1	1
Vaccination and treatment	2.10	1.30	0.80	0.30
Dairy product preparation	0	2	2	0
Average	1.01	2.04	1.125	0.45

Source: World Vision, 2006.

[18] Throughout this chapter, the term "milk" refers to fresh, raw milk.

Farm-gate prices and home consumption of milk

Farm-gate prices vary across the country, depending on the local production system and access to markets. For example, according to market sources, the average farm-gate price in Southern Punjab, a major rural and remote milk producing area, is US$0.30/litre, while that in Karachi, Pakistan's largest urban fresh milk market, is US$0.40/litre.

In all production systems where market access is available, an average of 2 litres of milk per day is set aside for home consumption. Subsistence smallholders with limited or no access to market tend to consume all their milk production, or process it into traditional products with longer shelf-life, such as khoya and ghee, for later sale in large markets. Small farms practising peri-urban production market the surplus milk after satisfying their family needs.

DAIRY VALUE CHAIN

Owing to consumer preferences and lack of technology, almost 95 percent of the milk in Pakistan is marketed raw through informal marketing chains; the remaining 5 percent is processed by the formal processing industry and marketed through the formal chain.

The major difference between the two types of marketing chain is the sophistication of their storage and handling infrastructure and practices.

Informal marketing chains

Milk collection

An informal marketing chain requires a closely interlinked network of milk collection agents, known as dodhis. Dodhis are the most important milk procurers in the country, and provide most farmers with their main links to the market. Based on the scale of their operations, dodhis can be classified into three main categories, which act as a hierarchically tiered collection and bulking system:

a. *Small (katcha) dodhis* are responsible for door-to-door collection, of up to 100 litres per day each.
b. *Medium-sized (pucca) dodhis* purchase mostly from small dodhis, collecting 400 to 800 litres per day each.
c. *Large dodhis (contractors)* purchase mostly from medium-sized dodhis, collecting 40 to 70 maunds[19] of milk per day (Raja, 2003).

Milk bulking

Approximately 80 percent of milk in Pakistan is produced by *rural* dairy farmers (FAO, 2003). Of this, about 60 percent is consumed at source and the remaining 40 percent is marketed through katcha and pucca dodhis (FAO, 2006a). Dodhis sell 85 percent of the milk they procure to contractors, 10 percent to collection/procurement agents of dairy processing plants, and 5 percent to bakers or confectioners. Contractors sell 90 percent of their milk to retail shops, and some to processing plants, bakers and confectioners.

Peri-urban producers contribute 15 percent of the milk supply. Of this, 80 percent is sold directly to consumers, 5 percent to dodhis, and 15 percent to retail shops.

Urban producers are responsible for 5 percent of production. Of this, 15 percent is sold to retail milk shops, and the remaining 85 percent direct to urban consumers. There is little or no reliance on dodhis in this production system.

These milk marketing chains are presented in Annex 10.

Milk quality testing and cooling

Dodhis generally purchase milk on the basis of quantity rather than quality. Considering the high perishability of milk, existing marketing infrastructure in Pakistan is generally weak, and is non-existent in many areas. Owing to an absence of proper roads, many milk producing areas are difficult to reach. Cold chains are also lacking, owing to high procurement and operational costs. For instance, a farm cooling tank of 200-litre capacity costs US$3 313, and one of 1 000-litre capacity US$6 812[20].

Milk is stored in basic, non-food-grade containers and, depending on road conditions, transported on various means, ranging from donkey carts and bicycles to large trucks.

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[19] 1 maund = 37.3242 kg.

[20] Industry estimates; prices include power generator sets, as few rural areas have grid electricity supplies.

Producer payment systems

Farmers are often paid monthly, under post-sales contracts between dodhis and farmers. As dodhis are major sources of loans, advance annual payments are often made to farmers, based on a flat daily price. In summer, when retail prices of milk increase, the marginal price premiums are not passed on to the farmers. In addition, as dodhis purchase on quantity rather than quality criteria, farmers selling high-quality milk do not receive any incentives.

Processing and retailing

As well as using fresh milk[21] in tea, the traditional Pakistan diet includes yoghurt, lassi, ghee, butter, cream and milk-based sweetmeats. In the informal market, this demand is satisfied by various agents, including producers, milk traders and confectioners. Approximately 7 to 8 percent of the fresh milk marketed is used for commercial processing of these products[22].

Most processors are small-scale operations, with a dual role of manufacturing and retailing their products directly.

Processing stakeholders

Subsistence farmers in remote rural areas with no regular access to market often convert milk into ghee and khoya for later sales in a nearby town. The creamers situated on the periphery of large towns purchase whole milk from large contractors. They then separate the milk from the cream for sale to retailers or processors.

Urban milk retail shops sell raw or boiled milk, and also process some milk into products such as yoghurt and lassi to sell directly to consumers. Confectioners and tea shops use milk and cream as raw products in the items they prepare for retail sale.

Processing activities

The informal processing industry is the locally preferred source of goods, and uses manual labour or basic technology such as mixers, ovens and furnaces. End-products are often sold unpackaged, but polyethylene wrapping may be used for butter. Products provided by the informal processing industry are relatively affordable for local, mostly low-income, consumers.

Dairy product safety and quality testing

Processors often purchase milk based on quality criteria. Traditional methods, such as smelling or boiling the milk are used to detect any curdling or adulteration.

Processing operations are often carried out under unhygienic conditions. For instance, milk traders often boil milk in rusty woks, and some retail shops are in locations where dust, flies and dirty water give rise to hygiene concerns.

Processing costs and margins

Costs in the informal processing industry depend on the sophistication of operations and the type of products produced. For example, a shop retailing fresh milk only has to invest in labour and equipment for boiling, while a confectioner requires a higher level of inputs.

Generally, production costs include manual labour, premises rent, and fuel, ranging from fuelwood to electricity. Capital investment is required for storage equipment and processing machinery. Processing margins depend on the seasonality of milk and dairy products supply and demand, market location, target market segment, and type and quality of end-product. No formal studies have determined the processing margins in the informal industry, but they are estimated to range from US$0.0125 to $0.0375/litre.

Formal marketing chain

The formal milk marketing chain comprise the large-scale corporations engaged in producing ultra-high temperature (UHT) processed milk. The three large market players are Nestle, Engro Foods and Chaudhry Dairies.

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[21] Pakistanis do not consume much milk on its own, preferring to use it in tea. Dairy households also prepare butter, cream, lassi, yoghurt, etc. for home use.

[22] Author's estimate; an official study would be needed to determine the actual quantity.

Milk collection

Although direct procurement from farmers is preferred, fragmented and subsistence farming forces processors' collection agents to procure from dodhis and contractors. According to interviews, approximately 60 percent of Engro's milk supply comes directly from farmers, and the remaining 40 percent through intermediaries. Nestle collects more from farmers, and Chaudhry Dairies more from collectors.

The processing industry is seeking to increase its vertical integration by setting up corporate dairy farms as an experiment[23]. Such measures are expected not only to help control supply but also to lower the costs of setting up a collection network.

Milk testing and cooling

Milk is collected from individual farmers and dodhis on the basis of quality criteria, often set at 6 percent fat content, with price premiums paid for higher contents. Payments to farmers and dodhis are often made once or twice a month.

Formal processors use a cold chain for bulking and transporting milk. Farm cooling tanks (FCTs), owned and operated by processors, are set up in villages. Milk from the FCTs is transported in refrigerated tanks to regional collection facilities for onward transfer to centralized processing units.

Processing volumes

Currently, at least 11 large-scale dairy processing plants operate in Pakistan, with a minimum daily operational capacity of 0.1 million litres according to industry estimates (military processing plants are not considered). Annex 11 gives a list of these plants and their operational capacities. On average, these plants are operating at 50 percent of their capacity.

In addition, actors from the food services sector, such as Nirala (confectioner) and Gourmet (baker), are involved in formal processing. Nirala collects fresh milk for use in its sweets, while Gourmet sells pasteurized milk through its retail baking outlets.

Dairy products

The main dairy product in the formal sector is UHT milk. Other products include butter, cream and yoghurt, which account for about 5 percent of total processed products[24]. Two to three medium-sized processors are involved in pasteurization for local sales.

Packaging

UHT milk is packaged in tetrapaks, extending its life to up to three months. The packaging costs an estimated US$0.10/litre of milk.

Processing costs and margins

Owing to intense market competition and investment by only a few companies, reliable data on production costs and processing margins are not available. Estimated processing costs, outlined in Table 7, average PRs 12.25/litre, while distributor and retail margins average PRs 10/litre, resulting in gross processor margins of PRs 32.75/litre.

Distribution and retailing

Processed milk is packaged on-site using modern technology, and is stored in company warehouses to be transported through the marketing chain via a sophisticated distribution system delivering to retail stores.

Retail costs and margins have not been studied, so statistics are not available. The main costs involved are premises rent, as retailers need neither to store nor to perform any processing functions. Gross retail margins are based on agreements with distributors, and are estimated to average US$0.0375/litre.

[23] Engro has recently set up a modern dairy farm, keeping approximately 1 700 imported Australian cows under a sophisticated management system.

[24] Author's estimates.

TABLE 7
Processing margins in the formal marketing chain

Activity	Estimated cost (US$/litre)
Milk procurement	0.287
Collection	0.025
Processing (UHT)	0.028
Packaging	0.10
Total processor production costs	**0.44**
Retail margin	**0.0375**
Distribution margin	**0.087**
Gross processor expenditure	**0.565**
Retail price	**0.687**
Processor margin*	**0.112**

* Does not include operational costs such as marketing.
Source: Industry interviews.

Chapter 7
Discussion and conclusions

This chapter gives an overview of recent trends in the dairy sector and their potential impact on dairy sector development in Pakistan. In light of these trends, critical bottlenecks for development are identified, and recommendations made for successful dairy development in the country.

RECENT ISSUES AND TRENDS

Comparison of the livestock census reports of 1996 and 2006 indicates that the cattle and buffalo populations increased by 44.72 and 34.84 percent, respectively (Government of Pakistan, 2009). During this period, milk production increased at an average of 3.61 percent per year, or by a total of 38 percent.

In the past ten years, no change has been observed in annual average yields per cow, but average annual yields per buffalo have increased slightly, by 13 percent[25]. An increase in farm fragmentation was observed, with 11.7 percent more cows and 9.4 percent more buffaloes living in herds of only one to four animals.

The private sector has begun investing in the provision of inputs such as formulated feed, veterinary medicine, and cattle breeding through artificial insemination. Large-scale corporations have started to invest in the processing of UHT milk. The formal dairy processing sector has been the driving force behind the establishment of cold chains in remote milk producing areas, and in spreading the practice of quality-based procurement.

In the past three to five years, both the government and donors[26] have made investments in dairy development projects, which currently total US$612 million. The government has also recently started to grant import duty exemptions for the development of dairy.

Based on these recent trends, critical opportunities and needs for the development of Pakistan's dairy sector are presented in the following sections.

OPPORTUNITIES FOR FUTURE DEVELOPMENT

Pakistan's dairy sector presents immense opportunities for donors, government and the private sector. Donors and governments can work on employment generation and poverty alleviation programmes through investing in dairy, while a rapidly increasing population and high rates of urbanization[27] are the driving forces of increased demand for fresh and processed milk and products, providing opportunities for the private sector.

BOTTLENECKS

Development approach

The recent interest in the dairy sector has led to raised expectations. However, the following are critical flaws in the approaches being taken, which may prevent projects from achieving their desired impacts.

Isolated interventions

Many ongoing projects aim to address elements of the dairy value chain in isolation. This undermines the sustainability of results. For instance, most projects focus on enhancing yields by using on-farm feed sources to improve smallholders' livelihoods, but no projects address critical interventions in the input supply chain, such as developing a local feed industry and enhancing the distribution of formulated feed, which is a basic stimulator of production.

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[25] Extrapolated from FAOSTAT figures.

[26] CIDA, USAID and AusAid are among the donors with ongoing dairy development programmes.

[27] Pakistan's population of 160.9 million people in mid-2008 makes it the sixth most populous country in the world, with an estimated growth rate of more than 2 percent per annum. Pakistan also has the highest level of urbanization in South Asia; by 2030, 50 percent of its population is expected to live in cities.

Formal versus informal supply chains

Many donor-funded projects focus on linking smallholders to the formal marketing chain, which accounts for only 5 percent of the entire milk supply. As a result, impacts on the informal sector – which accounts for 95 to 97 percent of supply – are negligible. Such projects undermine intermediaries' role in the value chain, while attempting to link hurriedly formed farmers' groups directly to markets. These projects work on hygienic milk collection, handling and storage with only farmers, although the inclusion of dodhis would serve the interests of all agents in the value chain, including producers and consumers.

Similarly, almost all the government's financial incentives focus on taxes, imports, etc., which apply to only the formal sector.

Productivity-centric

Many projects claim that Pakistan's yield per animal is low because they are comparing it with yields in countries with different production systems, such as the United States of America and Germany. In fact, Pakistan's yield per animal is among the highest in countries of comparable socio-economic and climatic conditions, and is higher than those in India, Bangladesh, Sri Lanka and Nepal. Yields are compared in Annex 12.

The importance of enhanced productivity in responding to burgeoning demand should not be underestimated, but projects tend to ignore the root causes of low productivity. For instance, although considerable stress is put on training in improved farming practices, only one government-sponsored project is working on breed improvement[28].

Unclear goals

Most donor-funded dairy development projects focus on poverty alleviation and smallholders managing herds of one to four animals. However, medium-sized (with five to ten animals) and large farmers (with more than ten animals) provide about 50 percent of the total milk supply. These projects therefore have a limited impact on developing the dairy sector and improving the milk supply for urban consumers, while issues such as hygiene and the environment are likely to be addressed only partially.

Project versus programme orientation

Most ongoing donor initiatives are oriented towards projects rather than programmes. This is also true of government initiatives, many of which are funded by donors or international financing institutions. Such an approach can limit the impacts. For instance, under one government-funded project, extension workers are being trained and housed in facilities rented by the project. When the project finishes, the continuity of many of its benefits is doubtful.

Overlapping goals and objectives

Many ongoing projects have overlapping goals and objectives. For instance, at least two federal government-sponsored programmes and one provincial programme are organizing milk collection using FCTs. Such multiple implementation mechanisms blur responsibilities, create confusion among beneficiaries, and duplicate efforts, at the cost of valuable resources.

INFRASTRUCTURE AND TECHNOLOGY

Most major milk producing areas in Pakistan are situated in riverine areas with poor road infrastructure. This, coupled with expensive storage technology such as electricity-powered FCTs in a power-deficit country, makes it impossible for milk to be transported to large urban centres where demand is high.

The lack of a reliable cold chain also forces private sector processors to invest in producing UHT instead of lower-cost and affordable pasteurized milk.

FARMERS' ORGANIZATION

Farmers in Pakistan are not organized and there is no organized production and marketing in the agricultural economy. This leaves farmers with little bargaining power.

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[28] Improving Reproductive Efficiency of Cattle and Buffaloes in Smallholder Production Systems.

GOVERNMENT SUPPORT

The government plays a major regulatory role and is responsible for enforcing laws, including those related to food safety. It also provides support services, such as veterinary care and extension. However, the government's financial and human capacity is weak and cannot cover the large fragmented farm base or widely spread marketing chain.

INPUTS AND RELATED SERVICES

There are constraints in various categories of inputs and related services.

Information

Few data are available on dairy production, demand, markets, employment, etc. Where available, the data provide few options for cross-referencing or validation. In the absence of reliable and complete information, policy-makers, investors and donors are unable to make effective decisions.

Inputs

Although the private sector has started to invest in providing inputs, such as feed, veterinary support and artificial insemination, the coverage of these services is often limited to peri-urban, market-oriented farmers, owing to the fragmented rural production system, low levels of education among rural farmers, and costs that are too high for many smallholders. With a 10.3 percent inflation rate (Government of Pakistan, 2009), the cost of inputs is high, especially compared with lower output prices.

Water – a critical input for buffalo production – is scarce. Pakistan's per capita water availability has declined from 5 600 to 1 200 m^3 per year over recent decades, and may fall to the water-deficit level of less than 1 000 m3 per year in 2010.

Financial services

Lack of physical assets to serve as collateral restricts livestock farmers' access to formal credit at all levels. The entire agriculture sector faces this problem, and recent government interventions are opening up the finance sector. For instance, the State Bank of Pakistan has set a quota for agricultural lending from a pool of State and private banks. Although the banks have been exceeding their targets in this, only 11 to 15 percent of the loans have been utilized for livestock (Afzal, 2006).

RECOMMENDATIONS FOR DEVELOPMENT

Based on the opportunities and challenges in the dairy sector, this section recommends the key elements of a roadmap for successful sector development.

Elements in a dairy development roadmap

Objective

The overall objective of dairy development should be to establish a national dairy sector based on sound input supply, which provides hygienic milk, meets consumer demand in terms of quantity, and provides employment and income generation opportunities for farmers and other agents along the milk supply chain.

Major stakeholders

The main stakeholders in a dairy sector development plan should be the government, private sector input providers (feed, veterinary services, financing, cold storage, etc.), dairy farmers (of all size), intermediaries, processors (in the formal and informal sectors), distributors, retailers and consumers.

Guiding principles

Development of the dairy sector should be based on the following guiding principles:

i. Successful development depends on having the active participation of all stakeholders.
ii. Milk is part of an integrated, closely interlinked food economy requiring a unified approach to policy, infrastructure and investment. For example, hygienic milk can be ensured only by enforcing food laws on all food items. Targeting adulteration in the dairy sector while leaving it unchecked for other food items is unlikely to gain the support of dairy market agents.

iii. Accurate, reliable and verifiable statistics are needed to guide dairy development policies and programmes.
iv. Support to the different strata in the dairy sector should be based on demand and aligned with sector trends, realities on the ground and development priorities. Projects should therefore be developed for both large and small farmers, and for both traditional and modern markets.
v. Improvements in isolated areas of the milk chain will have limited results and little likelihood of being sustained. Single institutions or projects are unlikely to be able to address the entire value chain, so major efforts should be implemented in coordination.

Roles of major stakeholders

Public sector

The public sector should play a regulatory and coordinating role, providing key inputs in specialized areas such as vaccine and breeding research, and sector statistics. This would mean, for instance, reducing the public provision of services such as extension, while increasing regulation of the quality in private extension.

Government support is also needed for the establishment of cooling infrastructure under projects such as the National Trade Corridor, worth US$10 billion and funded by the World Bank and ADB with the aim of developing trade infrastructure throughout Pakistan.

The public sector should also provide the private sector with incentives for improving the dairy sector, such as through larger tax and duty exemptions on lower-cost storage tanks.

Private sector

The private sector should be involved in all operational aspects of the value chain, including extension, veterinary services, feed provision, artificial insemination, and milk sales and distribution.

Donors

By providing guidance to both the public and private sectors, donors play a pivotal role in the socio-economic development of Pakistan. When designing and implementing projects, it is important that donors coordinate their efforts rather than duplicating them. Donors should also be mindful of the impact of projects on the development of the dairy sector, and have clearly defined goals. It should be mandatory for all projects implemented to publish key information, such as industry studies and baseline surveys.

Potential investment areas for FAO are in coordinating projects, gathering statistics on the dairy sector, reviewing policy and technology options, breeding, feed, genetics, and the strengthening of government capacity to facilitate the value chain.

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Annex 1
Livestock population, by province

Million head

Year	*Punjab*		*Sind*		*KPK*		*Baluchistan*	
	Cattle	*Buffaloes*	*Cattle*	*Buffaloes*	*Cattle*	*Buffaloes*	*Cattle*	*Buffaloes*
1996	9.382	13.101	5.464	5.615	4.237	1395	1.341	0.161
2006	14.412	17.747	6.925	7.340	5.968	1.928	2.254	0.320
2006 % of total national herd	48.76	64.93	23.41	26.85	20.16	7.05	7.61	1.17

Sources: Livestock Census Reports 1996 and 2006

Annex 2
Livestock population and annual milk production

Livestock population (million head)										
Species	1998/1999	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008
Cattle	21.72	22.00	22.42	22.85	23.30	23.75	24.21	29.56	30.67	31.83
% change		1.29	1.91	1.92	1.97	1.93	1.94	22.10	3.76	3.78
Buffalo	22.03	22.66	23.33	24.03	24.75	25.51	26.29	27.33	28.15	28.99
% change		2.86	2.96	3.00	3.00	3.07	3.06	3.96	3.00	2.98
Annual milk production (million tonnes)										
	1998/1999	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004	2004/2005	2005/2006	2006/2007	2007/2008
Milk production	30.34	31.17	32.05	32.95	33.90	34.89	35.90	38.12	39.36	40.64
% Change		2.74	2.82	2.81	2.88	2.92	2.89	6.18	3.25	3.25

Source: Agricultural Statistics of Pakistan (various years).

Annex 3
Production systems and their characteristics

Production system	Number of animals	Marketing channels
Smallholder subsistence	1–3	Milk not marketed owing to lack of regular access to market. Markets processed goods such as desi ghee
Smallholder market-oriented	3–5	Retail shops, intermediaries, procurement agents of dairy processing plants
Rural commercial	More than 50: 90% buffaloes, 10% cattle	Retail shops, intermediaries, procurement agents of dairy processing plants
Peri-urban	100–200: 90% buffaloes, 10% cattle	Sales to retail shops, contracts with intermediaries, direct sales to consumers

Source: Analysis of Milk Marketing Chain.

Annex 4
Changes in herd size, 1996 to 2006

Herd Size	Buffaloes		Difference	Cows		Difference
			%			
	1996	*2006*		*1996*	*2006*	
1–4	42.6	52	9.4	38.3	50	11.7
5–10	37	29	-8	37.2	28	-9.2
> 10	20.4	19	-1.4	24.5	23	-1.5

Sources: Livestock Census Reports 1996 and 2006.

Annex 5
Imports of milk

	Imports of Milk									
	1998/1999	*1999/2000*	*2000/2001*	*2001/2002*	*2002/2003*	*2003/2004*	*2004/2005*	*2005/2006*	*2006/2007*	*2007/2008*
Quantity (000 tonnes)	16.54	15.18	7.44	4.37	8.81	4.68	8.37	20.17	22.26	10.25
Value (US$ million)	16.67	14.43	7.64	5.03	7.80	5.28	11.24	24.00	38.06	23.75

Includes imports of milk, cream (not solid sweet and solid sweetened) and milk powder with fat content from < 1 to > 6 percent.
Source: Agricultural Statistics of Pakistan.

Annex 6
Wastewater sources and estimated quantities

	Source	Quantity (m3/m3 of milk processed/day)
1	Vehicle/tanker washing	0.5–12
2	Cooling water from different sources	2–7
3	Containers, equipment and floor cleaning	1.5–7
4	CIP water	0.5–1.5
5	Steam condensate	0.5–1.5
6	Condensed water from milk evaporation	0.5–1
7	Boiler blow down	0.04–0.06
	Total	5.5–30

Source: ETPI Survey.

Annex 7
Ongoing projects in dairy development

Name	Donor	Year started	Value (US$)[29]	Major objectives/goals and geographic coverage
Pathways and Purse String: Market Access for Women Producers in Pakistan[30]	CIDA	2008	5.78 million	**Objectives:** The overall objective of the project is to facilitate market access and linkages to provide a recognized role to women milk producers. **Geographic coverage:** District Kasure and Rahim Yar Khan in Punjab Province
Agriculture Sector Linkages Program (ASLP)	AUSAID	2005–2006	4.73 million	**Objectives:** The main goals of the agriculture linkages component are to:[31] • transfer Australian knowledge and expertise to key sectors of Pakistan agribusiness • increase profitability and enhance export potential • contribute to poverty alleviation of smallholder farmers through collaborative research and development • enhance the capacity of the Pakistan research, development and extension system to deliver targeted and practical research outputs to agribusiness and farmers. **Geographic coverage:** Two districts in Punjab Province (Bukkur and Okara) and 100 dairy farmers.
Empower Pakistan: Smallholder Dairy Development Project: Grants to Increase Productivity and Incomes of Women Dairy Farmers in Pakistan	USAID/ Pakistan[32]	2009	35 million	**Objectives:** • Enhance productivity of the livestock and dairy sector. • Enhance the incomes of small women dairy producers. • Increase the opportunities for women's employment and incomes. • Improve quality of milk. **Geographic coverage:** 3–5 districts in southern Punjab and northern Sindh.
Community Empowerment through Livestock Development and Credit (CELDAC) Programme	UNDP/DFID	2006	5 million	**Objectives:**[33] Enhanced income and employment generation of rural women through livestock skills development, improved livelihoods and food security at the household and community level. **Geographic coverage:** • Punjab and Sind.
EU – NWFP Milk Packaging Project	EU-sponsored Strengthening of Livestock Services Project (SLSP)	2005	N/A	**Objectives:** • Organize farmers for milk production and marketing. • Set up a pasteurization unit linked to participating farmer groups. **Geographic coverage:** Districts Nowshera and DI Khan in KPK.

[29] US$1 = PRs 80.

[30] www.meda.org/whatwedo/productionmarketinglinkages/wherewework/longtermprojects.html.

[31] Agriculture Sector Linkages Program (ASLP): Goals, Priorities and Activities.

[32] USAID/Pakistan, Program Framework, Empower Pakistan: Smallholder Dairy Development Project.

[33] Project Document, Community Empowerment Through Livestock Development and Credit, UNDP Pakistan.

Name	Donor	Year started	Value (US$)[29]	Major objectives/goals and geographic coverage
Prime Minister's Special Initiative for Livestock	Government of Pakistan	2007	24.9 million	**Objectives:** To increase milk output to 40 million tonnes and create another 3 million jobs in rural areas. **Geographic Coverage:**[34] 80 districts (ICT, 16 KPK, 34 Punjab, 13 Sindh, 7 Balochistan, 5 NA, 4 AJK) with 1,963 union councils.
Pakistan Dairy Development Company (PDDC)	Government of Pakistan	2006	4.33 million	**Objectives:**[35] • Improve the dairy sector through improved research facilities. • Train and build capacity of farmers. • Train veterinarians. • Improve the cold chain through milk chillers. • Promote healthy pasteurized milk. • Develop model commercial dairy farms. • Focus on breed improvement. • Facilitate credit financing for dairy farmers. • Link rural farmers to the market mechanism. **Geographic coverage:**[36] National.
The Livestock and Dairy Development Board (LDDB)	Government of Pakistan	2007	19.85 million	**Objectives:**[37] The main objectives of the project are to: • demonstrate the economic and social benefits of improved extension services for smallholder dairy farmers • enhance the scope and quality of information used for training extension personnel • enhance the research capacity of Pakistani scientists in priority fields relevant to the ongoing development of the dairy sector • promote the benefits of agency linkages and enhanced extension services to national and provincial research and extension agencies and NGOs. **Geographic coverage:** National.
Improving Reproductive Efficiency of Cattle and Buffaloes in Smallholder Production Systems (LDDB)	Government of Pakistan	2007	6.18 million	**Objectives:** **• Establish semen production units in public and private sectors for provision of low-priced, good-quality semen.** **• Provide artificial insemination services to farmers within 15 km of 10 military farms.** **• Establish an embryo transfer technology centre at Okara with production of 5 000 embryos per year.** **• Field trials with farmers' animals for embryo transfer, for production of pure-bred elite animals.** **Geographic coverage:** **Note applicable.**
Establishment of Milk Processing Plant (EMPP)	Government of Punjab, Pakistan	2007[38]	6.25 million	**Objectives:** To promote sustainable livestock development through productivity enhancement and improvement of incomes from livestock. **Geographic coverage:** District Sialkot, Narowal, Gujranwala, Hafizabad, Mandi Bahauddin and Gujrat.

[34] Livestock Sector Development Initiatives in Pakistan, R.H. Usmani, Animal Husbandry Commissioner, Ministry of Food Agriculture and Livestock.

[35] The White Revolution – Doodh Darya. A publication of the Pakistan Dairy Development Company.

[36] www.pddc.com.pk.

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[38] USAID/Pakistan, Program Framework, Empower Pakistan: Smallholder Dairy Development Project.

Annex 8
Commonly used adulterants

Adulterant	Chemical contamination
Dirty water	Penicillin
Singhara flour	Urea
Maize flour	Sodium Bicarbonate
Guar meal	Formaline
Chalk	Hydrogen Peroxide
	Detergent powder

Annex 9
Overview of food safety laws

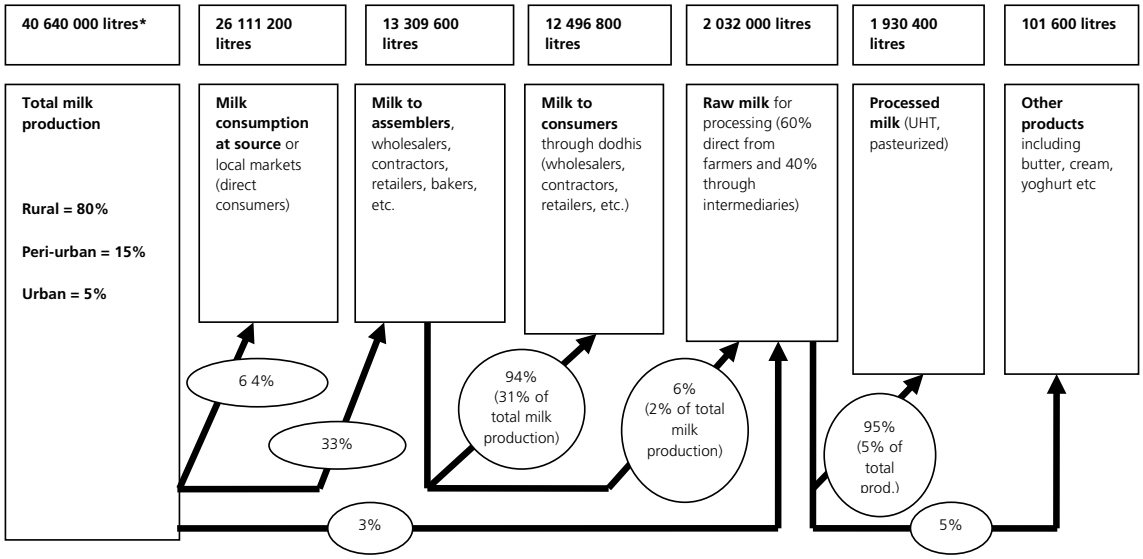
The Pure Food Ordinance, 1960 consolidates and amends the law in relation to the preparation and sale of foods. All provinces and some northern areas have adopted this law with certain amendments. Its aim is to ensure purity of the food supplied to people via the market; it therefore provides for preventing adulteration. The law prohibits any person to mix, colour, stain or powder any food, if the mixing involves violation of prescribed rules or is likely to make the food injurious for health. The prescribed rules set standards for colouring, preservatives, flavouring compounds, antioxidants, stabilizers, anti-caking agents, non-nutritive constituents, and metals. The law also prohibits sale, preparation, manufacture, import or export for human consumption of food that is unsound, unwholesome or injurious to health, in addition to misbranded food items. The law also sets rules for labelling of pre-packaged food, and precautionary measures to be taken during storage, stocking and packing. Four criteria are adopted by the law to ensure purity of food: a) it prohibits manufacturing/preparation or processing of food that is likely to be unsafe for human consumption, e.g., any food that can cause food poisoning; b) it prohibits import, export or sale of unsafe food; c) it sets out hygiene standards; and d) it provides for inspection and laboratory analysis of food samples according to set criteria. Local authorities are designated by the government to be responsible for enforcing the ordinance within their jurisdictions. The law is not uniform in all areas. Even penalties for the same offence vary among provinces. The law says nothing about awarding compensation or damages to consumers.

The Pakistan Hotels and Restaurant Act, 1976 applies to all hotels and restaurants in Pakistan and seeks to control and regulate the rates and standard of service(s) by hotels and restaurants. In addition to other provisions, under section 22(2), the sale of food or beverages that are contaminated, not prepared hygienically or served in utensils that are not hygienic or clean is an offence. This law does not specifically mention consumers' right to lodge a complaint. However, this does not prevent any person from addressing a complaint to the controller appointed by the Federal Government for enforcement of the act. Consideration of the complaint is a matter of jurisdiction of the controller. Moreover, as in other food laws, the act does not provide for compensation to consumers in case of damage.

The Pakistan Standards and Quality Control Authority Act, 1996 is a relevant law although it is not classified as a food law. The act provides for the establishment of the Pakistan Standards and Quality Control Authority (PSQCA), which is the body for formulating standards or adopting international standards. It is also responsible for enforcement of standards in the whole of Pakistan, and has the mandate to inspect and test products and services, including food items, for their quality, specification and characteristics during use, and for import and export purposes.

Annex 10

Flow of milk from producers to consumers



*Total milk production for 2007/2008, Agricultural Statistics of Pakistan 2007 to 2008.

Annex 11
Processing plants and their operational capacities

Processor	Location	Monthly processing capacity[39] Capacity (million litres)	Capacity utilization (million litres)		Average monthly
			Flush	*Lean*	
Nestle	Punjab	1.3	1.3	0.78	1.04
HFL	Punjab	0.9	0.9	0.54	0.72
Millac	Punjab	0.3	0.3	0.18	0.24
Halla	Punjab	0.15	0.15	0.09	0.12
Prime	Punjab	0.1	0.1	0.06	0.08
Nurpur	Punjab	0.15	0.15	0.09	0.12
Nirala	Punjab	1	0.1	0.06	0.08
Dairy Crest	Punjab	0.15	0.15	0.09	0.12
Engro	Punjab and Sindh	0.35	0	0	0
K&K	Punjab	0.4	0	0	0
Khi Dairies	Sindh	0.1	0	0	0
Military	Punjab	0.18	0.18	0.108	0.144
Total		**5.08**	**3.33**	**1.998**	**2.664**

[39] Dairy SWOG, Strategic Paper on Pakistan Dairy Sector, 2006.

Annex 12

Annual yield comparison of South Asian milk producing countries

Annual yield/animal[40] (tonnes)					
Buffalo					
Year	*Pakistan*	*Sri Lanka*	*India*	*Bangladesh*	*Nepal*
2003	0.750403	0.089286	0.48999	0.025882	0.216146
2004	0.75451	0.083333	0.511417	0.025882	0.217722
2005	0.755894	0.086667	0.527024	0.025882	0.218137
2006	0.744014	0.083871	0.558704	0.025882	0.219048
2007	0.787546	0.087097	0.577102	0.025882	0.213303
Average[41]	0.758473	0.086051	0.532848	0.025882	0.758473
Cow					
Year	*Pakistan*	*Sri Lanka*	*India*	*Bangladesh*	*Nepal*
2003	0.365236	0.111864	0.188843	0.032245	0.051942
2004	0.364286	0.115517	0.204055	0.032389	0.052874
2005	0.365289	0.115254	0.21982	0.032369	0.05422
2006	0.368627	0.114876	0.229435	0.032351	0.055
2007	0.371622	0.117213	0.236955	0.032332	0.05483
Average[42]	0.367012	0.114945	0.215821	0.032337	0.053773

[40] Yield calculated by dividing total milk production by total livestock population.
[41] Represents the annual average yield of buffaloes from 2003 to 2007.
[42] Represents the annual average yield of cows from 2003 to 2007.

Annex 13
Templates

TEMPLATE 1

Business plan for investment in dairy buffaloes (in US$)[43]

Procurement of a dairy buffalo cow 1 month before calving (local breed)	**1 187.5**

Fixed costs[44]	**Total (US$)**
Housing/buildings	625
Machinery (fodder cutter, etc.)	250
Equipment/utensils	20
Total fixed costs	**895**

Annual figures

Proceeds	**kg**	**US$/kg**	**Total (US$)**
Milk per year	2 480	0.458	1 136
Culling[45] (live weight)	50	2.62	131
Newborn calf (3 months of age)			36.50
Value of manure, per day		0.124	45.26
Total proceeds			**1 348.76**

Variable costs[46]	**kg**	**US$/kg**	**Total (US$)**
Feed			
Green fodder			
Home-grown	17 160	0.017	291.72
Purchased	17 160	0.031	531.96
Dry fodder[47] (chopped wheat straw, etc.)	840	0.104 $	87.36
Concentrate[48]	960	0.47 $	451.2
Mineral supplementation	18	1.87 $	33.66
Animal health, medicine, breeding (artificial insemination)			15.41
Hiring/fuel for machinery, maintenance			12.68
Labour payment			82.5
Maintenance of buildings			1.48
Lease/rent of land			14.06
Total variable costs			**990.07* 1 230.31****
Gross margin			**358.69* 118.45****

Gross margin calculations included labour and fixed costs such as housing, utensils, etc. and interest on loans. The gross margin is calculated based on a yield of 2 480 kg of milk/buffalo/year. However, it is a general practice among dairy farmers to increase milk volumes by adding water, resulting in higher gross margins.
The margins in the table are based on small-scale commercially oriented dairy farms. Numbers will be different for smallholders (subsistence dairy farms), as expenses and profits would be affected by the resources available and economies of scale.

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[43] Based on field data collected by consultant.
[44] The buildings, machinery and equipments/utensils are used for all the animals in a herd (ranging from ten to 15 animals).The life of buildings and machinery for animals is estimated at ten years.
[45] A buffalo (500 kg) produces milk for ten years (average). The culling live weight is 0.10 percent per year.
[46] Milk is sold at the farm-gate, and no equipment is used for milking, etc., so transportation and equipment maintenance costs are not included.
[47] Dry fodder is given when green fodder is unavailable.
[48] Concentrate is given only to milking animals during their lactation period, which averages eight months.
* With home-grown fodder.
** With purchased fodder.

TEMPLATE 2

Calculation of cost of milk production and net margin/profit of milk from a buffalo (in US$)[49]

Assumption: A 500 kg buffalo producing 6.79 kg milk per day. Culling rate is 10 percent per year.

Proceeds	**kg**	**Units**	**US$/units**	**Total (US$)_**
Milk per year	2 480	2 480	0.458	1 136
Culling (live weight)	500	0.10	2.62	131
Newborn calf		1	36.50	36.50
Value of manure	7250	7250	0.0062	45.26
Total				**1 348.76**

Variable costs[50]	**kg**	**US$/kg**	**Total (US$)**
Feed			
Green fodder			
Home-grown	17 160	0.017	291.72
Purchased	17 160	0.031	531.96
Dry fodder[51] (chopped wheat straw, etc.)	840	0.104 $	87.36
Concentrate[52]	960	0.47 $	451.2
Mineral supplementation	18	1.87 $	33.66
Animal health, medicine, breeding (artificial insemination)			15.41
Hiring/fuel for machinery, maintenance			12.68
Labour payment			82.5
Maintenance of buildings			1.48
Lease/rent of land			14.06
Total variable costs			**990.07* 1 230.31****
Gross margin			**358.69* 118.45****
Gross margin per kg milk			**0.144* 0.047****
Gross margin/profit per kg milk[53]			**0.141* 0.044**

Gross margin includes labour and fixed costs such as housing and utensils. The net margin is calculated based on a yield of 2 480 kg milk/buffalo/year. However, it is general practice among dairy farmers to increase milk volumes by adding water, resulting in higher net margins or profits. The net margins and profits in the table are based on commercially oriented dairy farms. Numbers will be different for smallholders (subsistence dairy farms), as expenses and profits would be affected by the resources available and economies of scale.

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[49] Based on field data collected by consultant

[50] Milk is sold the farm-gate and no equipment is used for milking, etc., so transportation and equipment maintenance costs are not included.

[51] Dry fodder is used when less green fodder is available.

[52] Concentrate is given only to milking animals during their lactation period, which averages eight months.

[53] To estimate net profits, fixed costs for one year per animal (as in Template 1) are subtracted from gross margin.

* With home-grown fodder.

** With purchased fodder.

TEMPLATE 3

Dairy value chain and the major elements (based on information from the national review)

Value chain steps	Activities	Structure/systems
Production (on farms)	- Growing fodder - Feeding - Milking - Herd management and breeding	- 80% rural farmers - 15% peri-urban farmers - 5% urban farmers
Bulking and cooling	- Only factory testing at farm, or by intermediaries (dodhis) in informal value chain Mechanical testing in formal value chain using Gerber machine, etc. - Cooling using ice by intermediaries/assemblers; formal processors provide cooling facility at each collection centre	- Approximately 4 500 bulking and cooling centres[54] - Cost for collection PRs 2/litre
Processing and packaging	- Boiled milk and milk tea are major products of the informal processing industry. Other products include sweetmeats, yoghurt, buttermilk, butter and cream - UHT is major dairy product of the formal industry. Other products include yoghurt, cream and butter. Pasteurized milk and cheese sold only by three or four small processors - At processing plants various quality tests are carried out (both chemical and biological) - Informal industry sells in bulk or open packages. Formal industry packages in tetrapac (some use plastic bottles or polyethylene bags)	- 12 processing plants: 2 large, 4 medium-sized, and 6 small[55] - 3–5% of total milk marketed - Cost = PRs10.25 (PRs 2.25 for processing and PRs. 8 for packing) for formal processing - Cost in informal processing estimated at PRs. 1.25/kg
Transportation and distribution	- UHT and pasteurized milk – formal sector - Raw milk – informal sector	- Company-owned cooling tanks used for transportation of milk from collection centres to processing units. Packaged product is distributed through formal distribution agencies - Farm to market transport for raw milk in informal sector is by bicycles, motor cycles, rickshaws, donkey carts, small and medium-sized trucks without cooling facilities
Retailing	- Sale to individuals and institutions - Storage - Delivery - Quality control	- Fixed premises: retail shops and supermarkets etc for processed milk in formal sector - Fixed sales points such as milk and tea shops in informal sector. Also, mobile sellers: raw milk traders on foot, bike or vehicle
Organizations and institutions	- No more than two or three small producer associations, including Khyber Dairy in KPK and Momin Dairy in Karachi - Formal processors have collection networks in place, e.g. Nestle - Dairy development and enhancement of productivity organizations in the public sector	- Ministry of Livestock (government) - SMEDA - Livestock and Dairy Development Board - UVAS

[54] 2 500 bulking and cooling centres of Nestle, plus an estimated 2 000.

[55] Large-scale plants ≥ 1 million/litres capacity; medium-scale plants 0.2 to 0.9 million litres; and small-scale plants < 0.2 million litres. Based on data in Annex 11

TEMPLATE 4

The three most challenging problems facing the Pakistan dairy industry

Area	Opportunities	Partners
Input services and extension	- Provision of veterinary services and goods to currently underserviced farmers - Provision of feed to currently underserviced farmers - Provision of other services such as artificial insemination	- National and multinational companies - Local distributors - Provincial livestock departments - dodhis
Milk safety in formal and informal value chains	- Revision and updating of food safety laws - Revision and updating of milk safety standards - Consumer awareness - Intermediary awareness - Implementation of milk safety standards	- Provincial food departments - Pakistan Standards and Quality Control Authority (PSQCA) - Donor projects in dairy sector - Processors - Consumers
Inefficient long transport of raw milk	- Investment in energy-efficient milk bulking and cooling - Training of farmers in clean milk production Improved management of milk collection centres	- Dairy cooperatives - Dairy farmers' associations - Dairy processors - Raw milk traders - Other private enterpreneurs/ transporters

TEMPLATE 5

Public and private sector responsibilities for service provision in dairy development in Pakistan (based on information from the national review)

Service provision	Responsibility	Funding	Oversight	Comments
Breeding services	Public and private	Public and private	Public	Breed improvement – public Services such as artificial insemination – predominantly private
Clinical veterinary services	Public and private	Public and private	Public	-
Preventive veterinary services	Public	Public	Public	Only for the main contagious diseases; this could be implemented through contracting private veterinarians
Food safety requirements	Public	Public	Public	Food Department and PSQCA
Advisory services	Private and public	Private and public	Private and public	-
Milk collection	Private	Private	Private	Public sector projects in support of milk collection, e.g., small grants programmes to set up cooling tanks
Milk processing	Private	Private	Private	-
Research	Public	Public	Public	-
Education	Public	Public	Public	-
Infrastructure	Public and private	Public and private	Public and private	Large infrastructure such as roads and electricity – public Milk collection networks – private
Input supplies	Private	Private	Private	Most farmers underserved