A Comparison of Dairy Policies and Development in South Asia and East Africa

Part 2: Country Case Studies from South Asia and East Africa – Kenya, Ethiopia, Pakistan and India, and Final Synthesis

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DAIRY DEVELOPMENT IN KENYA

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History and status of the Kenya dairy sub-sector

Kenya has one of the largest dairy industries in Sub Saharan Africa, with a well-developed production and processing industry. It's over 5 million improved cattle constitute the largest such herd in Africa,[1] and represents more dairy cattle than the rest of the countries in Eastern and Southern Africa combined. In economic terms, the dairy industry is the single largest agricultural sub-sector in Kenya, larger than tea, and contributes some 14% of agricultural GDP, and 3.5% of total GDP (Hooton, 2004).

Except during extreme drought years, Kenya is generally self-sufficient in milk and other dairy products). Annual milk production is estimated at about 2.4 billion litres although the country has a domestic supply potential of 4 billion litres (Muriuki et al, 2003). About 64% of milk produced is marketed while 36% is consumed at home and fed to calves (Omore et al, 1999). Small quantities of dairy products have also been exported to neighbouring countries. Smallholder dairy farmers, estimated at over 1,500,000 households, account for more than 85% of the annual total milk production and 80% of the total marketed milk (Staal et. al, 2001). Dairy production is concentrated in the highland, high and medium potential areas of the country, occupying about 2.8 million hectares (GoK, 1991). Ranking milk production by administrative provinces shows that Rift Valley produces 47%, Central and Nairobi 31%, Eastern 11%, Nyanza 6%, Western 4% and Coast 1%. Besides growing crops for subsistence and commercial purposes, most dairy farmers keep 1-3 cows with their followers on land sizes that are typically about 1 hectare in the intensively farmed (i.e. high-potential) areas and about 2.5 hectares in the less intensively farmed (i.e. medium potential) areas (Staal et al, 1998).

Dairy production systems largely entail mixed crop-livestock farming, which includes other livestock (mostly poultry, sheep and goats), cash crops (e.g., coffee, tea, horticulture) and subsistence crops (e.g., maize, vegetables). Since gaining independence in 1963, significant changes in the dairy industry have occurred with a major shift towards smallholder production and marketing.

The livestock population is estimated at 10 million beef cattle, over 5 million dairy cattle and their crosses, 9 million goats, 7 million sheep, 800,000 camels, 520,000 donkeys, 300,000 pigs and 29 million chickens (Table 1). In the high potential areas with adequate rainfall and high population densities, exotic breeds of livestock and their crosses are kept for the production of milk, eggs, and red and white meat in smallholder and large commercial farms. Where the available land is limited, farmers use zero or semi-zero grazing systems and cultivate fodders for dairy cattle. In these areas, production is considerably market-oriented. In the low potential areas, production is mainly by large commercial ranches, mostly keeping improved livestock meat breeds. In the arid and semi-arid areas (ASALs), indigenous livestock breeds such as Zebu cattle are kept under pastoral and semi-pastoral systems

Table 1. Livestock Population Estimates ('000') in Kenya

Province	Cattle	Goats	Sheep	Poultry	Camels
Rift Valley	4,777	5,893	4,558	6,032	172
Eastern	1,826	2,475	1,048	3,934	96
Nyanza	1,516	800	737	5,409	0
North Eastern	1,018	783	421	236	520
Central	1,012	271	478	4,774	0
Western	936	161	172	2,785	0
Coast	887	916	395	2,157	59
Nairobi	23	19	9.5	2,548	0
Total	**11,995**	**11,317**	**7,818**	**27,875**	**847**

Source: 2002 Ministry of Livestock and Fisheries Development Estimates. Note that these official figures are regarded as significantly underreporting the numbers of dairy cattle, as described in the text.

The supply-side of the dairy industry can be traced to the beginning of European colonization in the 1920s when exotic (*Bos taurus*) dairy cattle breeds were introduced to the highlands, where

[1] In the absence of a livestock census since 1969, the numbers of cattle and smallholder dairy farmers has been a topic of speculation. A recent rigorous projection exercise estimated much higher levels of both than had previously been reported (Staal et al, 2005).

moderate temperatures and good rainfall created suitable conditions. Until the early 1950s, indigenous Kenyans were not permitted to engage in commercial agriculture, and so large-scale white settler farmers dominated dairy production to that point. Following the state of emergency in the liberation struggle in 1952 and the Swynerton plan of 1954, African farmers were allowed to own land, cultivate cash crops, and keep improved dairy cattle. Over time, smallholder farmers have gradually come to dominate in dairy production. That dominance has been somewhat attributable to the efforts of the government (with the support of its development partners and the private sector) to promote dairy production and marketing using a variety of policy instruments and strategies. These include:

(i) regulatory framework
(ii) feed prices and quality
(iii) breeding and artificial insemination services
(iv) tick control
(v) veterinary clinical services
(vi) investment in research
(vii) extension services
(viii) pricing and taxation policies
(ix) market and trade policy, and promotion of marketing services such as through co-operatives
(x) expansion of rural infrastructure (e.g., roads, electrification, water, etc)

These efforts significantly contributed to the rapid growth of the dairy industry until the early 1980s, when inadequate government budget allocations caused the quality of services to decline (Omore et al, 1999). The demand for milk and milk products is influenced by many factors including changes in (i) consumer prices, (ii) disposable incomes, (iii) urbanization, and (iv) consumer preferences (taste). The effects of some of such variables as price and income are briefly reviewed later in the report.

This review suggest that polices have historically targeted achievement of national development goals in food security, employment and income generation. These policies have influenced dairy production and marketing and have resulted in phenomenal increase in the contribution of smallholder farmers to total national marketed milk production. The policies have affected land tenure (transfer and subdivision from settler farmers to smallholders), deregulation of input and feed prices, decontrol of producer prices and government divestiture in the provision of public services (Nyangito et al, 2003). This has enabled considerable increase in private sector investments in feed production and distribution, privatization of delivery of veterinary services, and private sector involvement in milk processing and marketing. There are still areas that require both public and private sector participation to revitalize the dairy industry further.

Production Level Policy Issues

Legal and Statutory Framework

A conducive legal regulatory framework is important in facilitating growth and development in the dairy industry and the economy. The regulatory framework for the dairy industry consists of various laws enacted in a number of legal documents, not all of which are necessarily harmonised. These acts include the Dairy Industry Act (CAP 336, Laws of Kenya) which was first enacted in 1958 and established the Kenya Dairy Board (KDB) to regulate the dairy industry. The Act has been revised in the past (1962, 1972 and 1984) with the aim of improving sectoral performance in the dairy industry. Changes in the legal framework to support changing policy circumstances have generally lagged significantly various public policy pronouncements from senior government officials, which are often taken as “official policy” and implemented by officials on the ground. The Dairy Industry Act has been under a stop-start revision process during 1997 to 2005, but has still yet to be finalized and sent to Parliament.

The main functions of the KDB include (i) licensing of retailers, (ii) controlling of milk movement and quality, and (iii) appointment of dairy inspectors. However, the KDB lacks the necessary resources (personnel, laboratories and operational funds) to effectively implement its mandates (Muriuki et al, 2003,). Other regulatory bodies charged with regulating the milk market such as the Kenya Bureau of Standards and the Department of Public Health of the Ministry of Health seem to experience similar weaknesses.

Another important regulation is the Co-operative Development Act (Cap 390, Laws of Kenya), which governs all dairy marketing co-operatives. Despite good performance in many cases, most dairy co-operatives have not allowed sufficient farmer participation in their management. The Act was revised in 1997 to ensure greater farmer control, and less government intervention. In early 2004, it was being revised to promote the contribution of co-operatives to economic recovery and development, but has not been completed.

The Companies Act (Cap 486, Laws of Kenya) is another important legal and policy framework that provides for registration of companies engaged in various business transactions in the milk supply chain. These include (i) registration and licensing of milk processors, (ii) licensing of retailers, (iii) regulations of milk transportation, and (iv) inspectors’ regulations (by KDB). Violation of these regulations is liable to prosecution.

Another statutory body, the Kenya Bureau of Standards (KEBS) promotes adherence to standards in industry and commerce, and to undertake educational work in connection with the standards. The KEBS is established under the Standards Act (CAP 496, Laws of Kenya). These standards are intended to safeguard both consumers and producers for product quality and for fair commercial dealings. KEBS has specified the methods of analysis to be followed for various products (including dairy products) and has powers to enforce these standards even by prosecution, if necessary.

Generally, the policy environment has been evolving since early 1980s when various reforms were introduced, which stressed less government participation in markets for various goods and services. However, most legislative processes have not kept pace with changes in policy directions, such as new thinking introduced through Poverty Reduction Strategies. As a result, there is now a tangle of more than 20 delayed bills in Parliament that have some relationship to agriculture and livestock. Changes in policy implementation thus occur not through changes in legislation,, but rather through changes in interpretation and implementation, which seems to be allowed considerable flexibility. Thus some of the regulations that are contradictory to new policy directions are simply not enforced. Others are not enforced due to lack of adequate human, physical and financial resources.

Feed Prices

Feed prices were controlled by the government through powers vested in the minister charged with livestock, until 1987. The Kenya Farmers' Association (KFA) legislatively monopolized marketing of animal feeds. To reduce the cost of animal feeds, the government waived duty on imported feed ingredients and there are no additional taxes on manufactured feeds. Price deregulation in 1987 resulted in increased participation in processing and distribution of animal feeds by both the private sector and co-operatives in many different parts of the country (Mbugua, 1999). There is generally greater feed availability and usage in most parts of the country, although its quality is sometimes suspect. Lack of capacity to regulate has created an environment that does not deter or penalize some manufacturers from supplying sub-standard feeds, and variation in feed quality remains a critical constraint to increased farmer confidence in and use of concentrate feeds (Muriuki et al, 2003).

Animal Breeding Programmes

Animal breeding programmes have aimed at improving dairy productivity, shortening calving intervals, and enhancing herd fertility by minimising breeding diseases while eliminating the cost of keeping a bull (Rege et al, 2001). The rapid and widespread adoption of exotic (*Bos taurus*) dairy cattle has been a striking and positive feature in the history of livestock development in Kenya, beginning with their introduction by colonial settler farmers in the early 1900s. While annual milk production for local breeds (*Bos indicus*) ranges between 100 and 200 litres per cow, cross bred or grade dairy cattle in Kenya produce some 1400 to 1700 per year on smallholder farms, and more on larger commercial farms. These figures lag behind the genetic potential of the cattle, but still yield good profits to smallholder producers. As has been demonstrated in numerous developing country settings, exotic breeds of cattle when crossed with local breeds can significantly improve milk yields in a sustainable manner. Finding an appropriate exotic-local breed mix has been, at least nominally if not actually, the principal objective of various dairy-breeding initiatives by the Kenyan government and other development agents.

While there is no explicit animal breeding policy in Kenya (unlike say Uganda which developed a comprehensive National Animal Breeding policy in 1997), various livestock and other generic policy statements have provided some direction for the breeding programmes in Kenya. For example the National Livestock Development Policy (1980) provided some brief guidelines:

- Expanded breeding and selection through wider use of AI and bull camps
- Expansion of the dairy herd size and increase productivity per cow under intensive production systems through breeding and selection
- Expansion of the following services which were going to increase services
- Dairy recording
- Registration of cattle
- Bull evaluation (progeny testing)
- Rearing of bull calves from best parents under extension service
- Exploit government institutions and farms for stock breeding and multiplication of high quality cattle
- Produce high yielding disease resistant cattle types supported by necessary input and services

To a large extent these policies were implemented in the early 80's when government was still subsidizing agriculture, for example, the establishment of government multiplication farms, and recording and progeny testing. However, most of these effort mostly failed and broke down from the late 80's and in the 90's, either through lack of resources and management, or though the withdrawal of support during the liberalisation process.

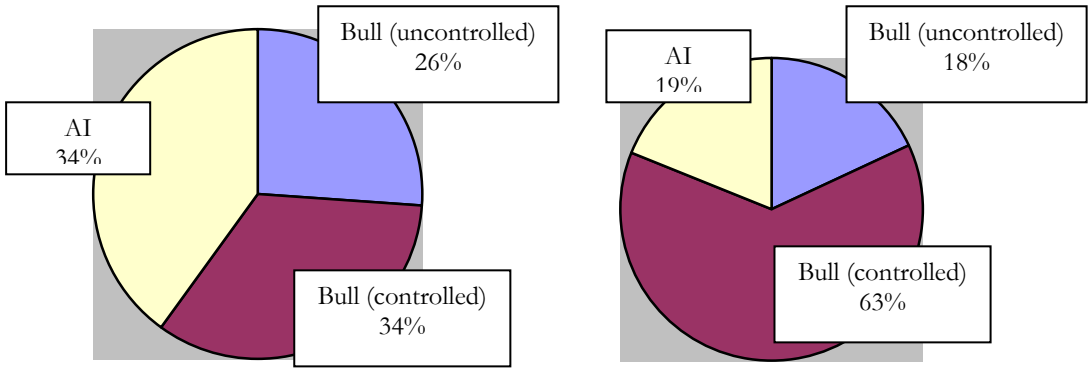
. Cattle breed improvement initiatives started almost a century ago when European settlers introduced dairy cattle breeds in Kenya. The Kenya Stud Book was established to keep animal breeding records in the early 1920s. Since then, major cattle breeding-related activities have been introduced. These include Livestock Recording Centre (LRC) to keep all livestock statistics and performance, Dairy Recording Services of Kenya (DRSK) - formerly Kenya Milk Records (KMR) - to keep all milk performance data; Central Artificial Insemination Station (CAIS) to produce semen and

the Kenya National Artificial Insemination service (KNAIS) to distribute semen (Conelly, 1998). To assist further the adoption of the higher yielding inputs and enhance dairy productivity, duties were waived on imported semen and embryos. However, the breeding efforts were not well co-ordinated and they suffered perpetual financial problems that rendered the breeding programmes ineffective.

Artificial insemination (AI) services were introduced in the 1940s. It was based on daily runs on motorized services and frozen semen. Initially the AI programme was quite successful especially amongst smallholders. The Swedish government was a major external financier in AI services. However, AI services did not escape the general problems of high operational costs and subsequent subsidies. Its decline started in 1979, with government inseminations falling from 548,000 a year to only about 60,000 in 1997 (Figure 2) This drop was accelerated by the progressive increase in the subsidised price of an insemination from the Ksh 1 (about 5-10 cents US depending on which year) that had been set in 1971 to an average of Ksh 580 for locally produced semen currently (some $7.25) post-privatisation, and double that price for imported semen.

In order to deal with these problems and as part of a wider agricultural liberalisation policy, the government decided to privatise AI service provision in 1991. It also licensed private companies to import genetic material. However the private sector has not grown sufficiently to replace the withdrawn government services. Instead many farmers are resorting to bull services of unknown quality. Figure 1 shows the rather dramatic shift from AI to bull service from 1990 to 2000 by highland dairy farmers.

Figure 1: Breeding services used by dairy farmers in Kenyan highlands



1990 Results **2000 Results**

Source: Baltenweck et al, 2005.

In addition to licensed AI providers, who are mainly vets, a few private large-to-middle scale commercial farms and cooperative societies run their own AI schemes using semen bought from CAIS. However since 1997, private provision of AI services has fluctuated raising concerns regarding the manner of privatisation and continued government involvement in AI service delivery.

There is considerable concern now on how to revitalize AI services within a liberalized environment in order to enhance dairy production in the country. The main issues affecting the breeding services revolve around

(i) lack of harmonisation of breeding organisations and activities,
(ii) government policy of not licensing inseminators trained by the private sector (as opposed to those with government training)
(iii) perceived high failure rates in AI services
(iv) high cost of private AI services, where available.
(v) Lack of availability or systems to produce stabilised cross-breed semen
(vi) Need for proper formulation of effective and viable bull schemes in areas where efficient AI is impossible or uneconomical
(vii) The need for a national breeding policies

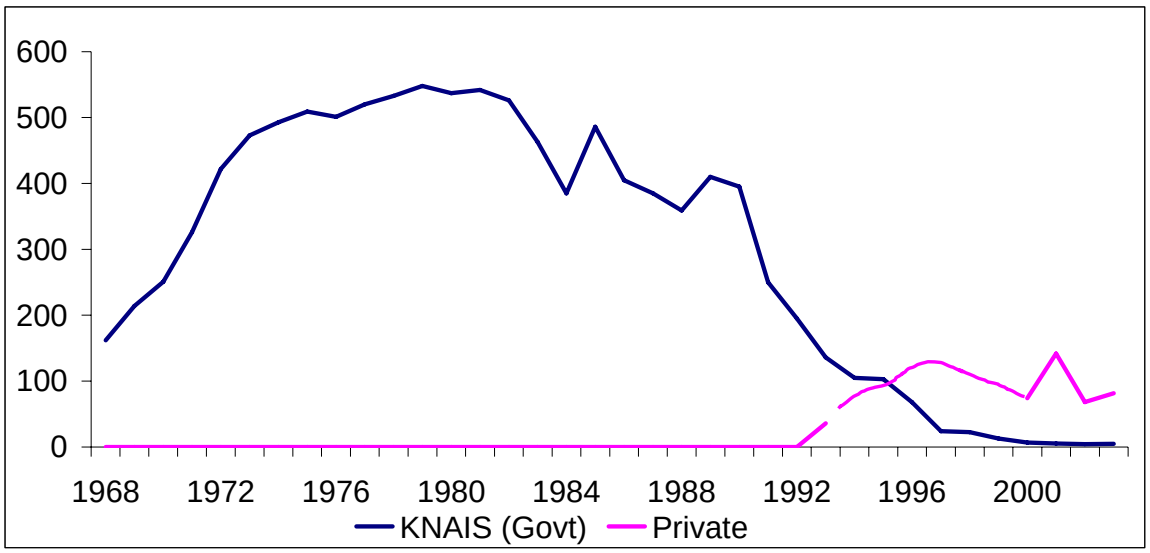


Figure 2. Trends in Annual Artificial Insemination Services ('000) in Kenya

Source: ILRI/KDDB Breeding Assessment Newsletter- Nov/ Dec 2003

The strong legacy from the colonial era, including AI, recording systems and breed societies, provided the impetus for a strong genetic improvement system. Government support to this, and external support particularly from Sweden, led to widespread uptake of improved cattle among smallholder African farmers. However, the liberalization and privatization process, lack of finance to government support institutions, have led to significant decline in the ability of support services to sustain genetic improvement, and in farmer use of AI.

Tick Control

One of the primary disease threats to dairy cattle in Kenya, particularly those with exotic genes, is East Coast Fever, a tick-borne disease which causes significant mortality. The practice of cattle dipping started in 1912 to control ticks and other disease vectors. Among smallholders, communal dips were the main approach in tick control programmes after independence and by 1987, there were 6,041 dips in the country. Disease and vector control programmes were a major source of success in the dairy industry although their management was however not very efficient. Following the collapse of government-run dip services, these dips were handed to local communities and were run by community management committees, on a revolving fund basis (Omiti and Muma, 2000). The success of this arrangement has been mixed to poor, with some reverting back to government supervision but with no improvement in service provision. Less than 50% of the communal dips were reported to be operational by the end of 1997 (Omore *et al*. 1999). Many farmers have opted to use hand sprayers due to the decline in dipping services.

Clinical Veterinary Services

Due to increasing dominance of smallholders, clinical services were started in 1974 when the first clinical centre was opened to cater for smallholders. By 1978, eighteen clinical centres were in operation and expanded to about 284 by 1995. Clinical services operated with strong public sector support, including government-employed veterinarians and nominal charges for drugs. In 1988, the government started a gradual increase in the rate of cost recovery as well as encouraging the establishment of private veterinarians. After the liberalisation period of the mid 1990s, public intervention has focused on retaining surveillance and prevention of notifiable diseases such as anthrax, contagious bovine pleural-pneumonia (CBPP), east cost fever (ECF), foot and mouth disease (FMD), heart water, lumpy skin disease and rinderpest. Since that time, clinical services have almost entirely been left to the private sector, with little attempt to support or coordinate that privatisation process. As a consequence, privatization of veterinary services has been generally slow and patchy, especially in areas with low concentrations of dairy cattle (Oruko et al, 2000). It is generally agreed that public-good type disease control interventions such a vaccination, should be supported by government veterinary services and/or public resources. In terms of clinic services, current policy is to provide public support to clinical services for producers in semi-arid and arid areas that depend heavily on livestock yet may not have resource to pay for services. In marginal localities on the fringes of the highlands, a mix of public and provide service provision is intended, with eventual staggered withdrawal of public support. In intensive high potential areas, the private sector is expected to provide all clinical services. Today, reliable access to clinic veterinary services is

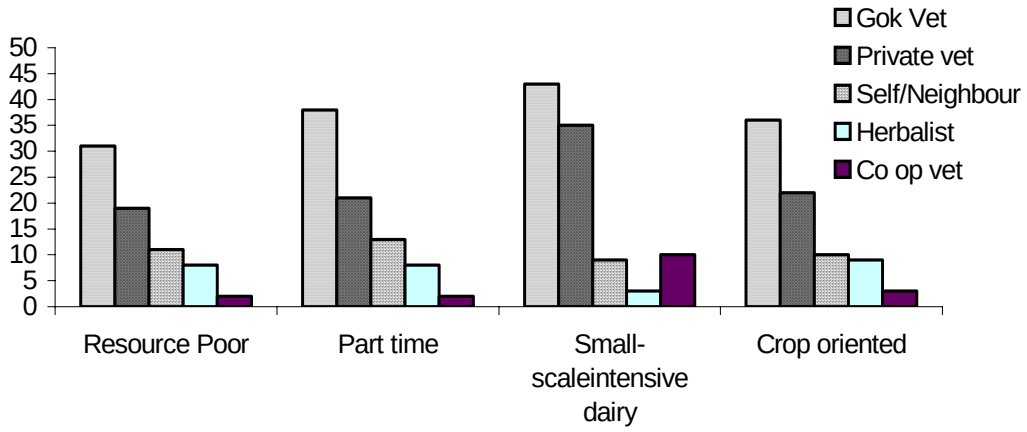
nevertheless problematic, and is variable for different types of dairy producers. Recent analysis by Baltenweck et al (2005) shows that up to 30% of farmers have no access at all to veterinary services, and among producers, the most resource poor have the least access, with only some 30% of that category reporting reliable access to veterinary services (Figure 3). Cost and quality of clinical services affect dairy productivity and are an important area of development policy concern.

Figure 3. Sources of veterinary services for different categories of dairy producers in the Kenya highlands.

Source: Baltenweck et al, 2005 (based on SDP household surveys, 1997 – 2000)

Investments in Dairy Research

By Sub-Saharan African standards, research in agriculture and livestock sectors in Kenya has relatively been well funded (Beynon et al, 1998). However, donor funding in agricultural research has been declining over the years (Figure 4), although . government investment as increased at the same time, leading to steadily increasing expenditure during 80s and 90s, in nominal terms. Data for investment in dairy research specifically are not available, but are likely to reflect and be a relativity significant part of general agricultural research investment.



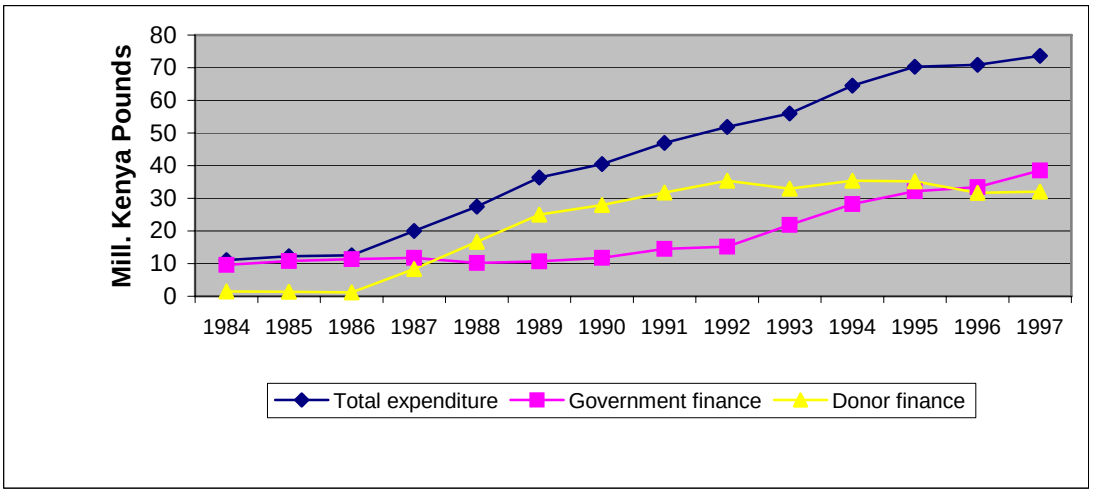


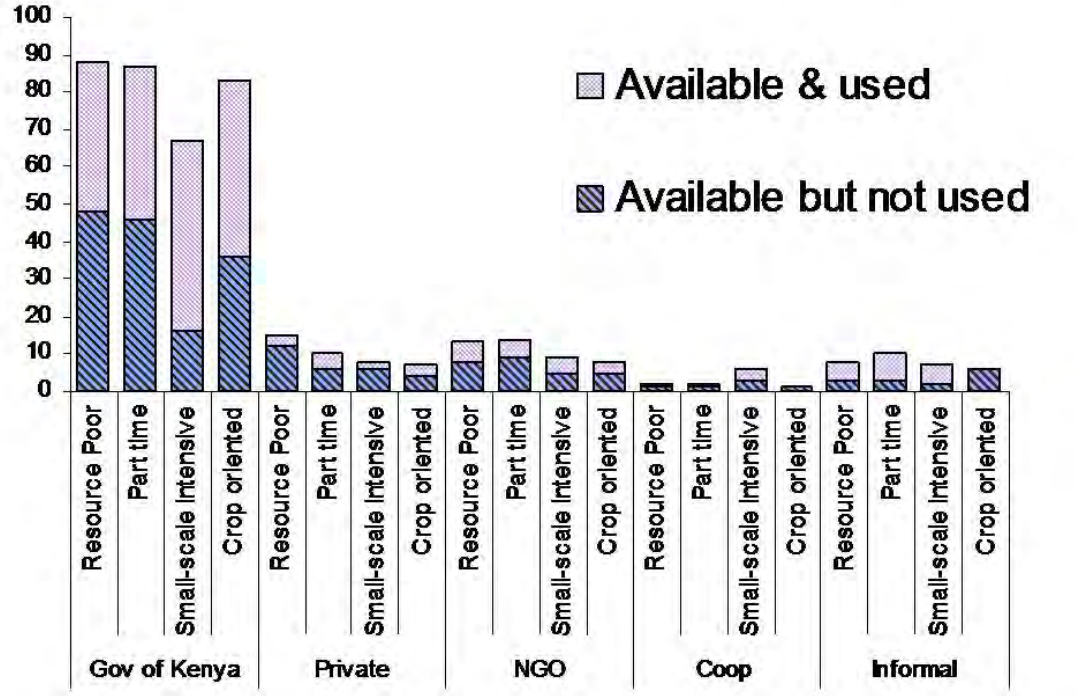
Figure 4. Expenditure trends in Agricultural Research (million Kenya Pounds)

To improve the effectiveness of research, in 1989 agricultural research activities were reorganized under one umbrella organisation – the Kenya Agricultural Research Institute (KARI). Thematic priorities in dairy research are: i) socio-economics; ii) feed resources and utilisation; iii) animal health; and iv) animal breeding/genetic improvement (KARI, 1996). KARI has started to actively encourage private sector participation in addressing these priority research issues, including financing of research activities that benefit them. Besides KARI, useful dairy research continues to be conducted at agricultural faculties at the University of Nairobi and at Edgerton University, Kenya Trypanosomiasis Research Institute (KETRI) and the Kenya Forestry Research Institute (KEFRI). The International Livestock Research Institute (ILRI) has been an active collaborator in a number of national dairy research activities including (i) KARI/ILRI collaborative research activities on smallholder dairy in the coastal lowlands; (ii) KARI/ILRI/MoA collaborative smallholder research and development activities in the highlands; and (iii) field testing of animal health technologies. The International Centre for Research in Agroforestry (ICRAF) is also involved in research aimed at improving natural resource management through the introduction of trees, including fodder trees. Of interest in the context of this study, is the fact that the new KARI Strategy currently being finalized, reported gives new and particular emphasis to addressing agricultural policy analysis and advocacy.

Extension Services

Through the national extension programs, there has been much effort to extend better dairy husbandry practices. Efforts have also been through training of human resources at university level, diploma, and certificate colleges. Donor agencies have also contributed greatly in enhancing the efficiency of extension services. Notable among these efforts is the National Dairy Development Project (NDDP) in the 1980s, that was funded by the Dutch government. However, during the general liberalisation programmes of the 1990s, public resources for extension services, including livestock, were generally reduced. Recent research shows that although most farmers report continued availability of government extension, many do not use those extension services, possibly reflecting lack of access (Source: SDP surveys, 1997-2000.

Figure 5).



Source: SDP surveys, 1997-2000.

Figure 5. Proportion of Kenya highland dairy farmers indicating availability and use of extension services from alternative sources.

Market Level Policy Issues

Overview of Pricing and Taxation Policies

For most of Kenya's post-Independence history, producer and consumer milk prices previously controlled by the minister in charge of livestock development, and later through the KDB. Generally, the government would announce pan-territorial prices that applied across seasons in the year. In 1971, a dry-season price bonus was introduced to assist with livestock feeding during the dry season that usually occurred between the months of January and April. Price legislation continued until the advent of the economic reforms that led to price decontrols in 1992. After liberalization, real milk prices rose by 20-40 % between 1992 and 1994, but they appear to have remained relatively stable since 1994 (Owango et al, 1998).

There are other direct taxes that processors and consumers pay such as Value-Added Tax (VAT) on farm and processing inputs as well as dairy products like fermented milk (maziwa lala), cheese, yoghurt, butter, etc. Up to 1997, the dairy industry was zero-rated whereby some magnitudes of VAT were tax refundable. Since then, the dairy sector became duty-exempt and this is a cause of concern in the industry. This is due to the fact that duty-exemption, while removing the need to collect VAT on milk sales, also removes the ability to recover VAT paid on inputs, thus increasing input costs relatively.

The KDB also levies a quantitative monthly cess deduction on all milk sold by a licensed party. Milk processors, milk bars, traders and co-operatives pay cess of KSh. 0.20 per litre handled. Failure to pay any amount of cess that is due will attract a penalty equal to one-quarter of the amount of cess the individual/company is in default. The cess is intended to be used for dairy development activities such as in the repair and maintenance of feeder roads but its usage leaves a lot to be desired.

Milk Marketing

The Kenya Co-operative Creameries (KCC) was registered as a company in 1925 and in 1932 it became a registered co-operative under the Dairy Industry Act (Cap 336, laws of Kenya). After its first creamery was opened at Naivasha in the 1920s, KCC rapidly expanded to become the biggest milk processor with 11 milk processing and another 11 Milk Cooling Centres (MCCs) with a combined installed capacity in excess of 1 million litres per day by early 1980s. A few farmers' dairy cooperative

societies (FDCS) also operate their own MCCs, some established through donor-supported dairy development projects.

The KCC had a nation-wide government-mandated monopoly all urban milk sales. Of milk supplied to the KCC, 34% came from large-scale producers, 54% came from small-scale producers through their cooperatives and 12% came from individual small-scale farmers who supplied the KCC directly. The KCC was regarded as the milk buyer of the last resort although it was not able to accept all the milk offered for sale during the flush periods due to plant capacity limitations, even though surplus milk was made into ultra-heat treated (UHT) milk for distribution to more remote areas and also primary schools under the School Milk Feeding Programme, skim-milk powder, and butter.

In May 1992, reforms took place in the industry and price controls were abolished to create a competitive, self-sustaining dairy industry, characterized by increased private sector participation (Owango et al, 1998). The liberalisation was interpreted to also imply the lifting of the KCC's urban milk monopoly, although that was never explicitly decreed. With liberalization, KCC milk intake showed a downward trend that led to closure of most of its processing plants. New private processors, co-operative societies, and informal milk traders became major participants in milk marketing. There are some 45 licensed processors handling less than 20% of the total marketed milk, while informal traders account for an estimated 38% of marketed milk. Currently, the dairy industry has a processing capacity of 2 million litres per day. The Kenya Co-operative Creameries is estimated to have a processing capacity of 1.2 million litres of milk per day and the other processors combined about 0.8 million litres of milk per day during flush seasons.

Informal milk marketing is especially important in rural areas although it also operates in "zoned" (urban) areas, even though hawking has been considered illegal for a variety of reasons. The main participants in informal milk markets are dairy co-operatives, milk bars, middlemen/traders, and farmers. (Figure 6). The high proportion of raw milk sales directly to consumers and through informal traders is an indication of low willingness of consumers to pay the extra costs of processing, and strong traditional preferences for raw milk, which is generally boiled before consumption. Although the informal raw milk market grew after liberalisation, it had always played an important role, contrary to the perceptions of many observers and industry players (Figure 7). What did change after liberalisation was more open activity by raw milk traders, and greater penetration into urban areas particularly Nairobi, formerly the preserve of the KCC.

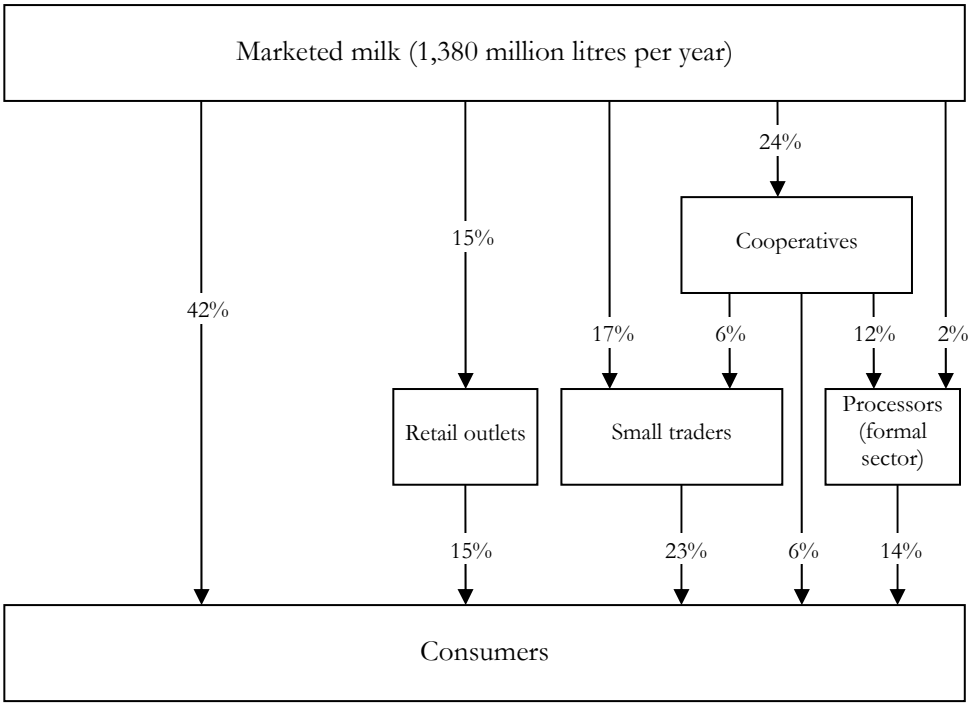


Figure 6. Milk marketing channels in Kenya

Sources: SDP Policy Brief # 4 (SDP, 2004c), Public Health Issues in Kenyan Milk Markets 2004 *Notes*: Percentage marketed flows are calculated on marketed milk, not on total production.

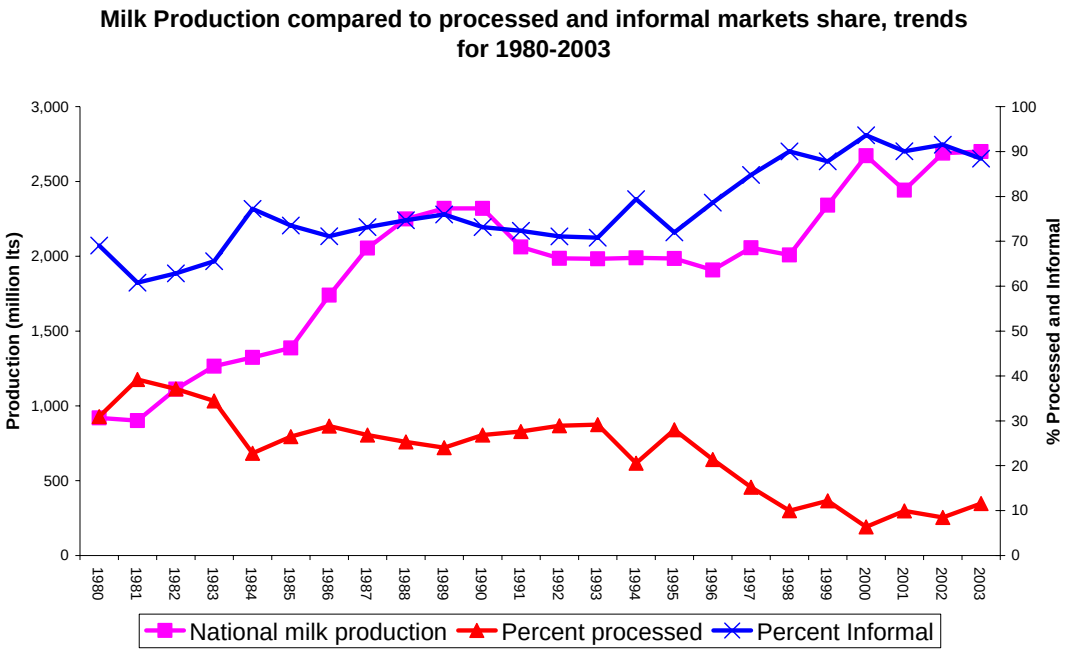


Figure 7. Trends in milk production, processed and informal milk market shares. Source: Gov of Kenya and KDB data.

Regulation and licensing of the many players in raw milk trade is a major policy issue. Although the dairy policy recognizes milk bars as a source of cheap (unpacked) and safe (pasteurized) milk, the dairy industry Act does not. Although retail shops are licensed to sell pasteurized milk, many of them use the license to sell raw milk. Traders/middlemen and farmers have in the past not been generally licensed to sell raw milk, although locally some authorities have granted such licenses. However, beginning in 2004 there was significant public policy debate in the media and among stakeholders about the role of raw milk markets to support small farmers and poor consumers. As a consequence of that, in the climate of a new reformist and pro-poor government, the Dairy Act is being revised to formalize raw milk marketing under minimum handling and packaging standards. This is regarded as a major pro-poor policy change, which is also now being adopted in other countries in the region, particularly Tanzania and Uganda.

Dairy cooperatives have played a critical role in milk procurement systems in some areas of Kenya. Where there are significant local milk surpluses that small-scale informal milk markets cannot handle, farmers' dairy cooperative societies (FDCS) provide a functional means to access larger formal markets. There are about 200 dairy cooperatives in Kenya, although only about 70% are functional. In recent years some members have abandoned their co-operative societies and opted to either operate independently or form Self-Help groups due to mismanagement and collapse of many co-operatives. Nearly all FDCSs sell raw milk locally at retail prices, and sell only the excess to processors, for which they receive a lower price. Some FDCS join the KCC as cooperative members so that they can supply the KCC with the excess milk that which they may find difficulty to market locally during the flush production periods. Currently however, most FDCSs sell most of their output to private processors, who now occupy the largest share of the formal milk market, who generally reduce prices paid during the flush season, and sometime limit quantities purchased when supply peaks. Thus, the formal and the informal marketing subsystems become intrinsically linked.

Dairy Imports and Exports

Kenya has been generally self-sufficient in dairy requirements in the past and has not experienced significant importation of dairy products except during years of extreme droughts.

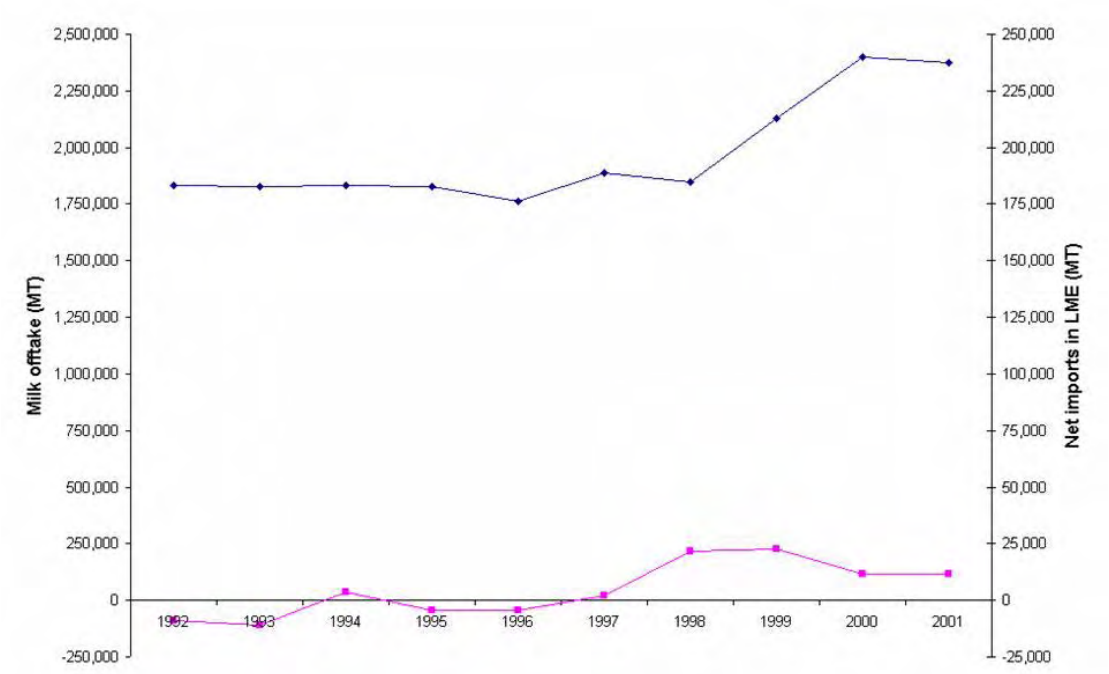


Figure 8. Total Kenya milk offtake and net imports, 1992-2001.

Sources: SDP Policy Brief # 3, Competitiveness of the Smallholder Dairy Enterprise in Kenya, (SDP 2004b.)

Kenya imports very small quantities of dairy products, usually less than 1 per cent of domestic production (Muriuki et al, 2003). Between 1985 and 1997, annual milk powder imports averaged 1, 444 tonnes. Since liberalization of the industry, fresh milk and butter exports averaged 158 and 381 tonnes, respectively (Staal et al, 2002).

Local dairy processors import small quantities of milk powder regularly, presumably to use in processed products such as yoghurt that may require the addition of powder, although they may also be reconstituting into liquid milk. In spite of the relatively small scale of milk product imports, they are often targeted as being a primary source of concern to Kenyan farmers. The duty on such imports was raised by almost 100% (from 35 to 60%) in early 2002 in response to a fall in the milk prices paid to farmers in some parts of Kenya. However, it was demonstrated that milk imports during that period actually fell by half, and that the farm-level price fall was almost certainly due to abundant rains during early 2002 through the normally dry period (Muriuki et al, 2003). In general, the engine to the Kenya dairy industry is the domestic market, and there is little evidence that trade policy will influence its fortunes.

Dairy Consumption Trends

The strong milk traditions in Kenya have led to some of the highest levels of milk and dairy product consumption of all developing countries. Traditionally, dairy consumption is mainly in the form of liquid milk (as tea) with a high preference for raw milk even among high-income urban groups. Raw milk is regarded as superior due to its high butterfat content, appealing taste and lower price. Raw milk is generally 20% - 50% cheaper than pasteurised milk, thus providing the poor population access to milk, one of the most healthy natural food products for both children and adults.

There is a higher percentage of households' consuming raw fresh milk (boiled before consumption), pasteurized milk, yoghurt and soured milk in recent years. However, more households consume home-made fermented milk, butter, tinned condensed milk and skimmed milk than a decade ago (early 1990s). Some of the products such as milk powder and UHT milk were more readily available then than now (Ouma et al, 2002), during the period of subsidized KCC production of those products from surplus milk. Yoghurt consumption is increasing because it is more available as a result of the increase in the number of processors. When all dairy products are converted into liquid milk equivalents, consumption of liquid milk averages over 97% of total dairy products, with higher consumption in rural areas than urban areas. Rural households tend to consume more raw milk and less processed milk compared to urban households. Quantities of dairy products consumed increase as income increases but the composition of the dairy products consumed changes with income changes (Ouma et al, 2000).

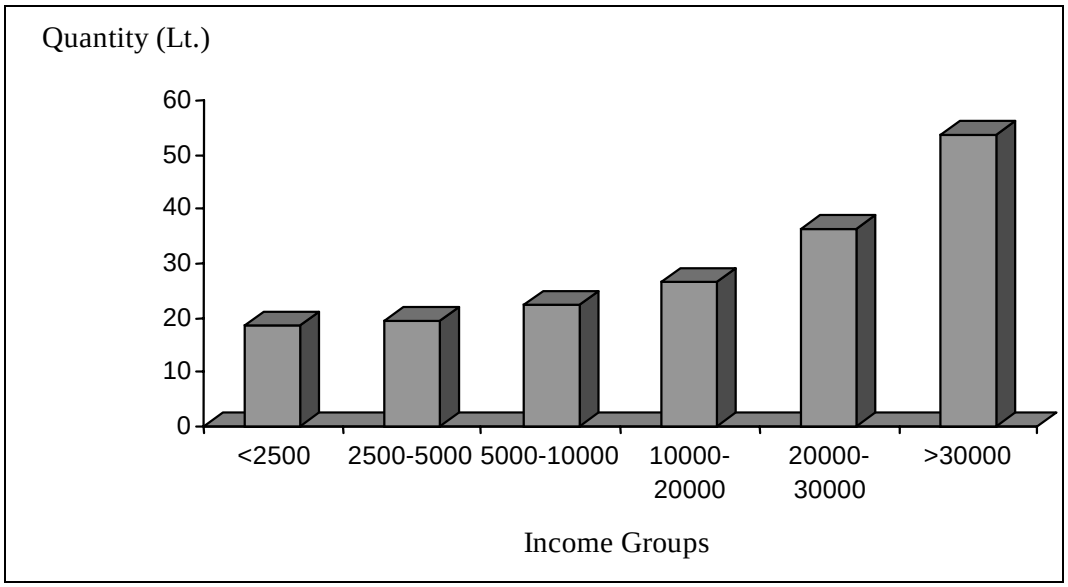


Figure 9. Average monthly consumption of dairy products per Household by income groupings.

Source: Ouma et al (2002)

Changes in population, urbanisation and the ability to purchase food have changed food expenditure patterns over time. Kenyan households spend a large share of their budget on foods (56%), with an expenditure elasticity of 0.93 (Staal et al, 2002). Expenditure on services averages 23%, much lower than food expenditure. Although as expected staple, cereals take the largest share in the household food budget, this is closely followed by dairy products (17% of all food expenditures), underlining the importance of milk in the Kenyan household diet. Estimates of per capita annual consumption range from 80 to 125 Kgs, depending on location, ethnicity and other socio–economic characteristics compared with per capita consumption of less than 25 Kgs for sub–Saharan Africa. In terms of unit milk consumption per capita GDP, a crude proxy for share of income spent on milk, Kenya is surpassed globally only by Mongolia and Mauritania (FAOSTATS). It is truly a major milk consuming country.

The budget share of raw milk is higher than processed milk derivatives among low-income households. This implies that consumption of more processed milk derivatives increases with income, depicting variations in purchasing powers across income groups. However, raw milk is highly income inelastic implying that demand does not change with changes in income levels. Demand for the highly processed dairy products is income elastic, with an expenditure elasticity of 1.10 implying purchase of more units with an increase in disposable income. This suggests that processed product consumption will increase with increasing incomes, but that demand for raw milk will also be sustained, pointing to continued growth prospects for the raw milk industry in Kenya

Analysis of Recent Trends in Dairy Development in Kenya

The dairy industry plays an important role in the livelihoods of the various farmers, traders, processors and other participants engaged in the entire milk supply chain. In recent years, the industry has witnessed phenomenal changes in policy leading to substantial reduction in milk supplies to KCC as described above (Figure 10). These changes have been due to a number of factors, including the removal of the monopoly and entry of other processors, but also due to increasing urbanization.

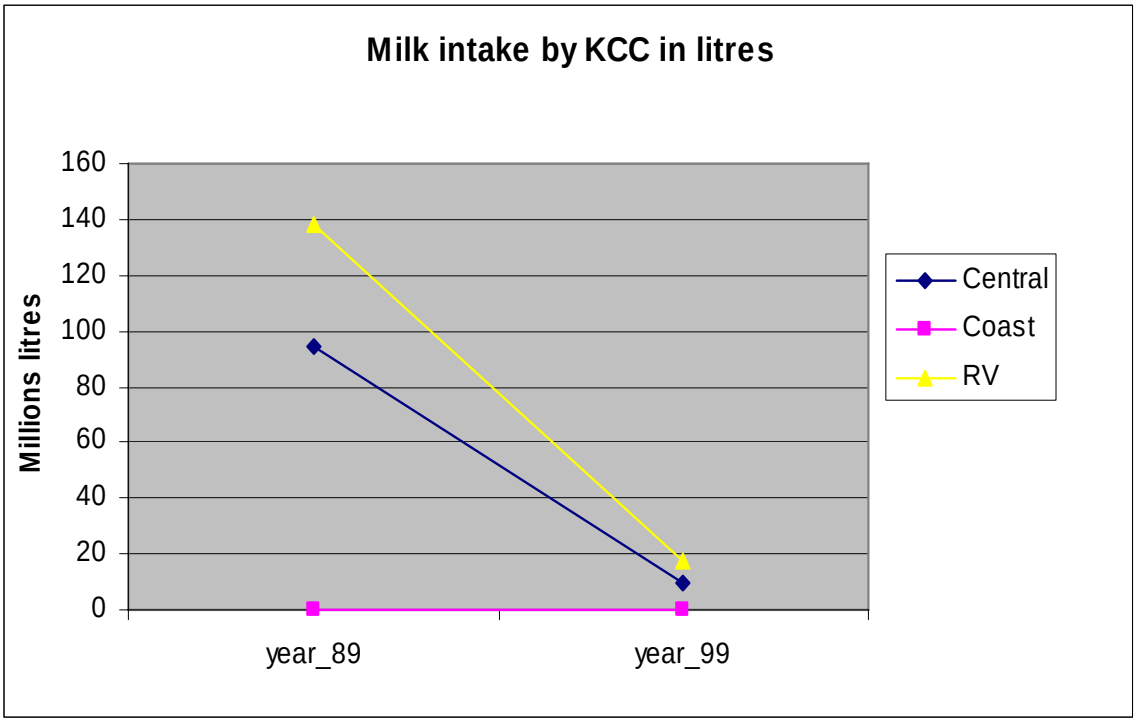


Figure 10. Changes in KCC milk intake, 1989 to 1999.

To better understand these changes, a regression model was fitted to capture these developments. Accurate historical data were very difficult to obtain, so the analysis is limited to a few points in time and regions. Data for the regression includes information for 5 regions: an aggregate of Central province, not including Nyeri, and information for each of the following districts: Kajiado, Nakuru and Narok in Rift Valley (RV) province and Mombasa in the Coast. The database covers information for two years: 1989 and 1999. As a proxy for dairy development, in a slight variation with the Conceptual Framework presented earlier in this report, the model uses as its dependent variable milk production per agricultural worker. The independent variables used are also based on the Conceptual Framework. Due to extreme limitations to the types of data available, a more complete model was not possible to implement.

The regression results indicate that the key factors associated with dairy development include: acreage under fodder production, urban population, enrolment ratio for primary school, percentage of household with electricity, and trends in the rest of the economy (Table 2). These contribute significantly and positively to the change in the dependent variable (milk production per worker).

In spite of the apparent historical role of the KCC, milk intake by the KCC is not shown to be significant during the period analysed. This points towards the relatively small role played by the formal sector, particularly during the 1990s, and the large and important role of the informal sector. This means that dairy farmers can be motivated to increase production through a variety of market channels. For each additional 1 percent of agricultural land put under fodder cultivation, milk production in the three provinces increases by about 0.91 percent. In the case of highland Kenya, the primary fodder for intensive dairy production is Napier grass (*Penisetum purpurum*), an elephant grass that yields very high quantities of fodder per unit land. Similarly, for each 1 percent increase in maize production milk production in the three provinces increases by about 1.38 percent. This accurately reflects the fact that maize stalks and stover, both green and dried, and key fodder sources for dairy production. A significant proportion of highland farmers depend on these by products from maize production for food, in order to feed their dairy cattle.

Table 2. Key factors affecting milk production per worker in 5 regions in Kenya, 1989 to 1999.

Variable name	Estimated coefficient	Standard error	Significant at 5 % level
Total milk intake by KCC per year (litres/year)	0.08	0.04	
Area under fodder in hectares	0.91	0.09	*
Area under maize in hectares	1.38	0.24	

Urban population	3.64	0.48	*
Enrolment ratio for primary school education	-10.58	1.28	*
Earnings by registered employee (K£'000] (income earned by those registered by NSSF)	0.29	0.08	
Percentage of households with electricity	-2.40	0.29	*
Rest of some dairy producing areas	-22.90	2.96	*
Constant	14.86	2.82	

Although the adjusted R^2 (0.9872) is high, this regression was run using only 10 observations due to data constraints and should only be considered as roughly indicating the effect of some variables on the development of the dairy sector.

Urbanisation is one major driving force in increasing demand for milk. For each additional percentage of population urbanizing in the three provinces, milk production increases by about 3.64 percent. Milk consumption per capita is higher in urban areas and hence the positive sign is consistent with effects of urbanization on demand for food items such as milk. Moreover, increase in disposable incomes drives effective demand of high-value food items such as milk and proteins. For each additional 1 percent increase of income in the three provinces, milk production increases by about 0.29 percent, although the coefficient is only significant at the 10% level.

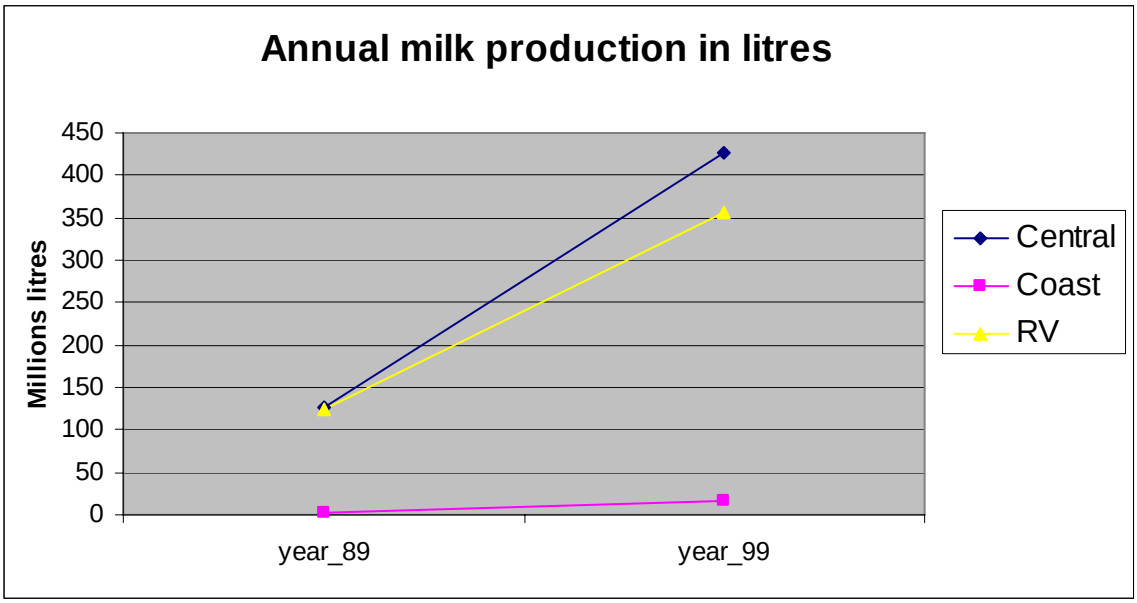


Figure 11. Trends in milk production in major milk producing areas

However, there are some factors that are negatively associated with milk production per worker. For example, for each additional 1 percent increase in the number of children enrolled in primary school in the three provinces, milk production per worker decreases by some 11 percent. School enrolment is a proxy for population, thus these reflect higher density areas, so production per worker is lower. Furthermore, for each additional percentage of households supplied with electricity in the three provinces, milk production decreases by about 2.4 percent. These results reflect lower production per worker and localities shift from rural to more densely populated, peri-urban settings. Finally, the constant term represents average milk production per worker for all regions included in the analysis, while the negative coefficient for districts in Coast and Rift Valley provinces means that on average, these districts show values of milk production per worker below the average values of regions included in the regression analysis (below Central province).

These basis regression results, while only indicative due to the extreme data limitations, supports key findings seen elsewhere: a) the formal market is not a requirement for dairy development, since the informal market as provided apparently effective market mechanisms, b) complementary agricultural development can support dairy production through fodder and potentially through its role in larger infrastructure development, and c) demand is critical to developing production of a relatively high-value good such as milk.

Income and Employment Generation in the Dairy Sector

Employment and Income Effects at the Farm-Level

Poverty-reduction and employment generation are important goals in various development strategies and policies in Kenya, including the recent Economic Recovery Strategy for Wealth and Employment creation (ERSWEC, 2003-2007) and the Strategy for Revitalization of Agriculture (SRA, 2004-20014). In these policy documents, it is recognised that dairy activities generate many employment opportunities in the course of milk production, processing and marketing.

There has long been estimated to be some 650 000 dairy farm households in Kenya (Omore et al, 1999). Based on random surveys of thousands of rural households by the Smallholder Dairy Project (SDP) in late 1990s and early 2000s, it is now clear that this number is much higher (SDP, 2005). SDP estimates from these surveys, followed by further ground-truthing surveys and complete censuses of selected locations, now indicate that there are some 2 million dairy farm households, keeping over 5 million grade or crossbred dairy cattle, mostly in the highlands. The employment figures below are based on these revised estimates of the size of the dairy sector.

Smallholder dairy farms depend heavily on family labour to perform various tasks in dairy. Dairy production is therefore an important source of self-employment especially for rural households. A significant proportion of dairy operators also engage hired labour, which may be long-term or casual, which creates employment among some of the poorest segments of society, including land-less households. Recognizing that most of the dairy activities occur in predominantly mixed crop-livestock production systems, it is not easy to attribute full time engagement of farm households to dairy activities alone over time and space. From existing surveys, it estimated that about 50 long-term wage labour opportunities are generated per 1000 litres of milk produced by farmers on a daily basis while some 3 persons are employed on casual basis per 1000 litres of milk produced at the farm level (Table 3). Even on the smallest farms, in total at farm level, some 77 people are employed full time for every 1000L of milk produced on a dairy basis. This is not an easy achievement considering, for example, that 2500 litres of milk flow per day are required in the Netherlands to generate a single job.

Table 3. Employment and income generation through dairying at the farm level

	Small Scale Farms ≤2 cows	Medium Scale Farms 3-6 cows	Large Scale Farms >6cows	Average
Self employment (Full time jobs/1000L of milk produced daily)	39	17	5	23
Permanent hired labour (Full time jobs/1000L of milk produced daily)	60	44	43	50
Casual labour (Full time jobs/1000L of milk produced daily)	6	2	1	3
Total direct farm employment per 1000L milk production	104	63	49	77
Average returns to labour from dairy production (KSh./year)	38,000	102,000	482,000	114,000

Source: SDP surveys, 1997-2000. These are based on detailed random structured surveys of over 3000 households in highland Kenya.

Dairy farming generates an average annual return to labour per enterprise of KSh 38,000 (US$ 475) for small-scale farmers and KSh 298,129 (US$ 6,025) to large-scale farmers, with an average weighted annual return of KSh. 114,000 (US$ 1,425). Compared to an average per capita GDP of approximately KSh 27,825 ($ 347) for Kenya (World Bank, 2003), dairying provides significant additional income to farmers. Dairying provides consistently higher returns than those available through rural wage labour.

Dairying is estimated to engage more than one third of the dairy farmers on full-time basis, which translates into some 256,000 self-employed persons. Small and medium dairy enterprises

account for most (87 %) of the employment that is attributed to dairying at the farm-level, largely because of their dominance in the dairy industry in the country.

Significantly, dairy farmers also engage full-time (permanent) hired labour for dairy production activities, and also occasionally hire casual labour. Hired farm labour for dairy is estimated to represent about 585, 000 workers full time country-wide, or about 24 % of the total agricultural labour force of some 2.5 M (Table 4). In total, some 841,000 people, or 34% of the total agricultural labour force are directly employed in dairy production at the farm level.

Table 4. Direct full-time employment created through dairying at the farm level

	Small & medium scale	Large scale	Total	Total employment in dairy as a % of the agric labour force
Self employment	245,000	10,960	256,000	10
Long-term hired labour	454,000	93,000	547,000	22
Casual labour	35,900	2,300	38,000	2
Total (numbers)	735,000	106,000	841,000	34
% of total	87	13	100	

Source: SDP dairy farm data, and JICA 2003 for total agricultural labour figures

Income and Employment Effects at Milk Market Level

Approximately 6 million litres of milk is traded daily in Kenya through both formal and informal small-scale and large-scale processors and traders. Beyond the farm-level, processing and marketing of milk and other dairy products offers numerous employment and income earning opportunities for the various participants in the milk supply chain. These include transporters, mobile milk traders, milk bars and shops/kiosks, small processors, service providers such as vehicle repairs, security firms and catering outlets. Mobile milk traders do not have fixed business premises. Milk collection from producers is mainly on foot, by bicycle or public transport.

Most small scale trader handle some 50-120 litres of raw milk daily. Traders with milk bars have fixed premises and mainly sell both un-pasteurised and fermented liquid milk. Besides family labour, wage employment is actively involved in running the milk bars. Small processors in Kenya mostly process and sell pasteurised milk, with a small proportion of throughput devoted to yoghurt and cheese, either as wholesalers and/or retailers. They are much fewer in proportion to other cadres of milk traders.

Labour requirements in the small-scale milk marketing activities include milk collection, transportation, processing and sale, to create direct and indirect employment. Direct employees are those who occupy themselves with the milk marketing and processing on a daily basis and include self, family and wage labour. Indirect employees are those involved in providing services to the dairy business e.g., artisan repairing farm equipment, bicycles etc. The overall number of both direct and indirect jobs created in the marketing segment of the supply chain varied from 3 to 20 depending on type and scale of enterprise for every 1000 litres traded on a daily basis (Table 5). This suggests that a significant number of jobs are created considering, the volume of milk that is traded via various intermediaries daily.

On average, informal milk marketing generates 18 jobs per 1000 litres of milk that is handled daily and this includes 15 direct job opportunities and 3 indirect jobs. The formal sector generates less employment per 1000L of milk handled on a daily basis (13) with 12 direct jobs and one indirect employee. Scaling out the employment effects to cover the whole country, formal milk processing and marketing generates about 15,000 jobs compared to the informal marketing that creates more than 39,000 employment opportunities to yield a gross total of about 55,000 jobs.

Further, these are relatively well remunerated jobs. From this study, it is estimated that formal employment in milk processing and marketing provides an average monthly wage of KSh 11, 936 ($150) while informal market agents earn an average of KSh 9,992 ($150), both much higher than the government's minimum wage guideline of $43.

Table 5. Traded volumes, employment and wage effects in milk marketing

		Small Scale	**Large Scale**	**Total**
Aggregate Milk quantities Handled (000'L/day)[†]	Formal Processing & marketing	122 (2%)	1,524 (25%)	1,646 (27%)
	Informal Marketing	2,682 (44%)	1,768 (29%)	4,450 (73%)
	Total	1,734 (46%)	2,041 (54%)	6,096 (100%)
Rate of employment generation (Jobs /1000L handled daily) [§]	Formal processing & marketing	**Small Scale**	**Large Scale**	**Weighted mean**
	Processing factory	11.6	4.5	4.9 (37%)
	Collection of raw milk	0	5.2	3.1 (24%)
	Distribution of processed dairy products	0	1.4	0.8 (7%)
	Retail of processed dairy products	3.1	3.1	3.1 (24%)
	Indirectly through supply of material & services to processors	1.2	1.2	1.2 (9%)
	Total number of jobs	11.6	12.1	13.1(100 %)
	Informal Marketing	**Small Scale**	**Large Scale**	**Weighted mean**
	Direct Employment	17	11	15 (83%)
	Indirect employment	3	3	3 (17%)
	Total number of jobs	20	14	18
Scaling out the number of jobs generated country-wide		**Small Scale**	**Large Scale**	**Total**
	Formal processing & marketing	905	14,177	15,082
	Informal marketing agents	15,620	23,950	39,570
	Total	16,525	38,127	54,652
Mean Wage (KSh. / Month)		**Small Scale**	**Large Scale**	**Weighted mean**
	Formal processing & marketing	7,810	12,199	11,936
	Informal marketing	9,550	8,137	8992

[†] Numbers in bracket shows the percentage market share for each category of milk marketing agent

[§] Numbers in bracket indicate the percentage contribution to the total number of jobs per 1000L of milk handled on a daily basis by each activity in the formal and also informal milk marketing sectors

Main Lessons from Kenyan Dairy Development

There are a number of important lessons that can be drawn from Kenya's generally successful dairy development history, and the policies associated with it.

Effects of key factors and policies on dairy development trends

- **Improved dairy cattle.** Grade and cross-bred dairy cattle, using European dairy genes, have had a clear and large positive role in the development of dairy in Kenya. The strong legacy from the colonial era, when AI, recording systems and breed societies, were established, provided the impetus to large improvements in productivity. This required large public investment, including from foreign donors such as Sweden and the Netherlands, and subsidized provision of genetic material. Clearly, use of exotic genes particularly in a temperate climate such as found in highland Kenya, is a rapid and potentially sustainable path to higher productivity, even among small and resource poor farmers.

- **Fodder technologies.** As demonstrated in the regression analysis, planted fodder technology has played a key role in growth in dairy productivity. This is nearly all due to widespread adoption of planting of Napier grass (Penisetum purpurum), a high biomass-yielding grass, apparently introduced originally as a mulch for coffee plants. Reflecting its importance, it currently occupies as much acreage in some parts of highland Kenya as does maize, the stable food (Staal et al, 1998).

- **Cooperative development.** Although the data available were not able to demonstrate this empirically, there is adequate evidence to suggest that particularly to the end of the 1980s, dairy cooperatives played a significant role in fostering dairy development, primarily in providing a stable market environment. Baltenweck demonstrated that historically, proximity to a cooperative milk collection centre was significantly associated with increased probability of a household entering successfully into the dairy production (Baltenweck, 1999).

- **Demographics.** Growth in urban populations and incomes appears to be linked to growing demand and scale of the dairy industry, and to diversification of products.

- **Policy reform and liberalisation.** There is considerable evidence to show that the period of policy reforms and liberalisation during the 1990s produced mixed outcomes for the sector. While price liberalisation and lifting of the parastatal monopoly led to more competitive milk markets and higher real farm prices for milk, access to livestock services appears to have suffered significantly. This is evidenced by the dramatic decline in use of AI, and also of farmer reported access to veterinary services.

- **Informal market development.** There is no evidence that investment in formal milk market processing, such as the KCC, has had measurable impact on dairy development. On the contrary, the growth in the dairy industry has continued even when the informal raw milk market has grown in share. This has been accompanied by a shift towards liquid and traditional products, apparently as a result of demand driven market responses, compared to the supply-driven product mix offered under the subsidized parastatal monopoly system.

Effects of trends, key factors and policies on the poor

The dairy industry is important in Kenya's economic development. As has been demonstrated, it supports many farmers, traders, service providers as a source of income and employment, and many even poor households as a daily source of protein, energy, and micronutrients. Development of the dairy sector has generally had clear benefits for the poor.

- **Public investment and support for smallholders**. A policy of "Africanisation" of production during the late colonial era, and after independence, deliberately brought smallholder indigenous farmers into the forefront in the dairy sector. This was supported in early years by relatively strong government extension system, and support to disease control, although those had weakened by the late 1980s. As a consequence, smallholders now dominate the dairy industry, and the opportunities that arise from it.

- **Income and equity in the dairy sector.** As shown in the employment section above, somewhere in the region of 900,000 people, more than a third of the total agricultural labour force, are employed in the dairy sector, some of them among the most resource-poor hired as labourers on dairy farms and over 85% of these numbers are related to small-scale production and marketing. Further, as also shown above, these employment opportunities on average yield greater incomes than available alternatives, both at farm level and in the market place. Although large scale producers show higher levels of returns overall, research has shown that unit profitability ranges between US$0.13 and US$0.16 per litre, and is not

significantly different between large and small producers (Staal & Omiti, 2005). Further, research has also shown that access to land is not a significant constraint to engaging in dairy production in Kenya, and that women-headed households are just as likely as male-headed households to be dairy farms. Both these indicators point to the dairy enterprise being viable option for even resource poor, socially marginalized households.

- **The informal market and the poor.** The informal raw milk market has been demonstrated to play a key role in providing important market outlets for small farmers, and for providing low cost milk and dairy products for poor consumers. It's strength is that is driven by demand for traditional products. The liberalization of the 1990s, in an unintended manner, helped grow the informal market.

- **Liberalisation of livestock services.** One area where policy is likely to have had a detrimental affect on the poor, is in the area of liberalisation of services. Access to and use of AI services has declined dramatically, and evidence suggests that access to veterinary and extension services has also declined. As shown in Figure 3, resource poor dairy farmers, the largest group, have lowest reported access to private veterinary services, those who were intended to fill the gap left by reduced public services. As an apparent consequence of the reduction in public services, duration analysis by Baltwenweck shows that the rate of adoption of dairy production by smallholder producers in highland Kenya fell significantly in the 1990s (Baltenweck 1999).

Policy opportunities and entry points, strategies and resources

Legislation. Dairy-related policy issues need to be coherently addressed, and legislation, under revision since the mid 1990s, to be updated and passed. Particularly important is to ensure that legislation and policy documents incorporate a) adequate inclusive stakeholder representation and institutional reform to implement that, and b) steps to formalize the large raw milk markets. Policy and legislative efforts should cast attention to the dairy sector within the broader national goals of poverty reduction, employment creation and food security, and look beyond the typical objectives of increase milk production and strict public health enforcement. Harmonization of the different acts that affect the dairy sector is required to reduce existing conflicts to facilitate faster sectoral growth.

Mainstreaming the informal sector. The informal milk marketing has enormous potential for off-farm employment generation, as demonstrated above. However, the efficient operation of, and potential evolution towards higher standards with the raw milk market has been impeded by the non-recognition of raw milk traders due to public health concerns. The mobile traders have often operated without trade licences and actively sought innovative ways and means to circumvent such official impediments to business operations. Research has shown that the quality of milk sold by the mobile milk traders is not significantly different from those with fixed premises and licences and that training can help improve quality (Omore et al, 2005). Very recently, in 2004 and 2005, the Kenyan Government has taken steps to "formalize" and legalize raw milk marketing, through training and certification of small scale traders. Where appropriate, institutions should explore alternative systems, such as self-regulation and partnership with the private sector. The required legislation to safeguard these policy changes is currently making its way through the legislative channels to be enacted. Similar changes have occurred or are occurring in other countries in East Africa, particularly Tanzania and Uganda. Thus even as income and urbanisation trends move towards a larger share of the formal market, this type of policy shift can mainstream the informal sector, and raise the quality of milk it handles, bridging the informal-formal gap as the industry develops.

Renewed public investment in livestock services. It's apparent that the withdrawal of government support to livestock services in the 1990s was not matched with increased provision of private services. Smallholders in particular, have lost access to some of these services. In order to support continued opportunities for resource poor farmers to increase productivity and opportunities in dairy, its likely that renewed public investment in services will be required until viable, appropriate private services are widely available.

Encouraging private service provision. The policy of simply vacating public services, with the expectation that private providers will step in, has failed partly because of continued barriers to private service entry. In particular, licensing requirements have restricted private sector participation. Changes that allow licensing of privately-training AI technicians, and animal health technicians, are needed to reduce barriers to private participations. Where that is not possible, sustainable alternatives should be sought, such as the introduction of cost sharing, or the training and equipping of community-based service providers.

Improving road infrastructure. Although improved roads benefit a variety of agricultural and rural sub-sectors, infrastructure is particularly important to dairy development, due the perishability and daily nature of milk collection. Research in Kenya shows that farmers may receive 3% less for their milk, for every kilometre of poor feeder road that separate them from the main road (SDP Policy Brief # 3, 2004b). Improved feeder roads are likely to have significant positive impact on dairy development.

Dairy Development in Ethiopia

Alejandro Nin Pratt, Mohammad Jabbar, Zelekawork Paulos, Elias Mulugeta

Introduction

In the late 1980s, agriculture in Ethiopia contributed about 45% of national gross domestic product. The livestock sector contributed about 40% of agricultural GDP or 18% national GDP, and 30% of agricultural employment. Dairy output accounted for about half of the livestock output (Feleke and Geda, 2001). More recent figures indicate that the livestock sector contribute about 12-16% of national GDP, about 30-35% of agricultural GDP, about 15% of export earnings and about 30% of agricultural employment. Livestock contribute to livelihoods of 60-70% of the population (Aklilu, 2002; Ayele et al.2003; Ejigu, 2003). Over the last 30 years national and per capita production and consumption of livestock products declined (Ayele et al.2003). During 1993-2001, per capita income remained at about US$100. Livestock production increased by much less than the production increase for the agriculture sector as a whole, so relative share of livestock to AGDP declined over time. During this period, per capita livestock output fell by 5% while crop, food and agriculture grew at 14, 7 and 6% respectively (Halderman, 2004).

During 19661-2000, milk production in Ethiopia increased by 1.55% annually while per capita production decreased by 0.84% annually. Per capita production turned mildly positive only after the introduction of structural adjustment and market liberalization policies since 1992 (Table 6). Due to declining per capita production over long term and decreases in net imports in recent years, per capita consumption decreased from about 26 litres in mid 1980s to about 16 litres in 2001 (Muriuki and Thorpe, 2001).

Table 6. Trends in total and per capita milk production in Ethiopia, 1961-2000

Period	Total production		Per capita production	
	Annual average, tons	Growth rate, %	Average, kg	Growth rate, %
1961-1974[a]	698, 555	1.63	24.07	-0.87
1975-1992[a]	869,181	1.66	20.62	-0.91
1993-2000	1,100,831	3.00	19.09	0.36
1961-2000	862,997	1.55	21.52	-0.84

a. Include figures for Eritrea, as separate figures were not available.
Source: Ahmed et al. (2003) based on FAOSTAT database

Estimates about specific contribution of the dairy sector to output, income and employment are not readily available. Four main dairy production systems may be identified in the country: a small commercial sector consisting of large private farms and state farms, small urban/peri-urban systems raising crossbred or both crossbred and local cattle having access to milk collection centres or cooperatives, smallholder mixed farming systems in the highlands using indigenous breeds, and pastoral/agro-pastoral system in the low lands. Reliable figures on the relative importance of these systems in terms of number of farms/herds, dairy population, share of milk produced are not available. However, a rough estimate indicate that currently, out of about 1430 million litres of milk produced annually, 900 million litres (63.3%) is produced by rural small-scale mixed farms in the highlands, 205 million litres (14.3%) by small urban/peri-urban farms in the highlands, 320 million litres (22.4%) by pastoral/agro-pastoral producers in the lowlands, and 5 million litres (less than 0.03%) by large private and state farms (Ahmed et al. 2003, Feleke and Geda, 2001).

Household consumption and expenditure surveys indicate that livestock products comprise only 8% of total food expenditure, with 4 percent of expenditure allocated to dairy products. About 56% of milk in the country is processed into butter, cheese and yoghurt and 44% is consumed fresh as shown in Table 7. Although levels of consumption vary according to income levels, relative shares of fluid milk and other products mainly butter remain about the same across income groups (Figure 12,)

Table 7. Use of milk in Ethiopia, mid 1990s

Use of milk	Million litres (milk equivalent)	Percent of total
Fresh/raw milk	630	44
Pasteurized milk	5	<1
Butter	595	42
Cheese	185	13

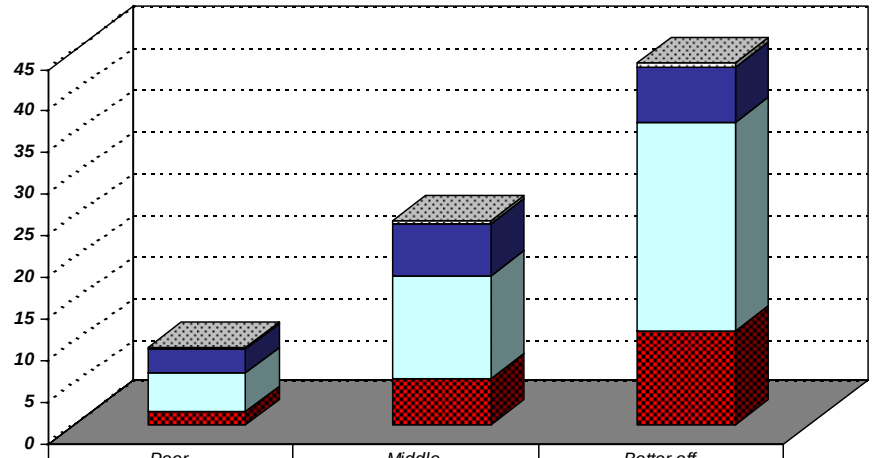
Yoghurt	15	1
Total	1430	100

Source: CSA 1997, 2001

Only a small amount of milk is processed into pasteurized milk, butter and cheese by large scale commercial processors. Most of the milk produced in the country is processed by the producers themselves on-farm into butter and soft cheese (*ayib*) for home consumption and sale. Rural producers far away from urban markets usually process surplus milk into butter because of difficulties in selling fresh milk locally and the main butter markets are in the towns and cities.

Apart from income, consumer preferences and dietary customs also partly explain relatively low demand for dairy products. Orthodox Christians comprising about 40% of the Ethiopian population abstain from consuming dairy and other animal products for about 200 days in a year. Thus, low demand for dairy products in Ethiopia compared to demand in other low income countries in Sub-Saharan Africa appears to be a major reason for the slow growth of the dairy sector.

Many factors other than demand have contributed to the stagnant nature of the overall economy and the poor performance of the dairy sector. The purpose of this section is to highlight some of the policy issues that contributed directly and/or indirectly to the performance of the dairy sector, explain the regional differences in dairy sector growth and marketing, and an assessment of potential for income and employment opportunities in dairy production, processing and marketing. Then conclusions are presented along with lessons learned.



	Poor	Middle	Better off
Other	0.11	0.34	0.65
Cottage cheese	2.99	6.23	6.47
Butter	4.52	12.38	25.13
Milk	1.73	5.58	11.32

Figure 12. Milk consumption by expenditure group in litres per capita (1995-1996)

Dairy Development Policies and their Impacts

Since the 1960s, three distinct periods can be identified from the point of view of policy: the later years of the Imperial regime (pre-1974), the socialist Derg regime (1974-1991), and the structural adjustment and market liberalization policies since 1991. Though Ethiopian rural economy is dominated by smallholder crop-livestock mixed farms, the objectives of various policies of the successive regimes over the last five decades have been similar, mainly focusing on improving commercial dairy production in selected areas of the country, especially around Addis Ababa, through introduction of exotic and crossbred cattle and related feed and management technologies, and development of a milk processing industry to supply Addis Ababa market. The policy instruments and operational procedures employed to achieve these goals varied over time in line with the politico-economic philosophy of the respective governments.

Imperial regime

The first attempt to introduce modern dairy production in the country was made by the Imperial Government in 1947 with 300 Friesian and Brown Swiss dairy cattle received as donation from the

United Nations Relief and Rehabilitation Administration. A small milk processing plant was established in Shola outside Addis Ababa to support commercial dairy production (Yigezu, 2000). Later missionaries, some foreign individuals and organisations also introduced small numbers of imported exotic dairy cattle breeds. Between 1959 and 1969, with additional support from the UNICEF, several steps were taken in stages to meet increased urban demand for milk. These included: expansion of the capacity of the Shola plant to10,000 litres per day and then to 30,000 litres; in order to supply the processing plant, opening of milk purchasing and collection centres throughout Addis Ababa, and later up to a radius of 70 km around Addis Ababa along main roads; limited extension service and incentives to well off farmers to take up commercial dairy production to supply the milk collection points ((Staal, 1995).

In 1971, the Dairy Development Agency (DDA) was created as an autonomous body to provide guidance and assistance, e.g. extension and credit to farmers to establish commercial dairy farms in areas serving the cities and townships , and improve the quality and increase the quantity of milk and milk products (Ketema, 2000;Yigezu, 2000). Under this scheme, 30 medium farms (40 milking cows each) were established with imported exotic cattle, 885 grade and crossbred in-calf heifers were distribution to medium and small farms, and 13 new milk collection centres were constructed and renovated. With the encouragement of the DDA, cooperatives came into existence to undertake commercial agricultural production including dairy but cooperatives did not engage in milk collection in that period. Members were those with larger land holdings for dairy production purposes (Alemayehu, 1998). At that time the DDA used to pay lower prices to farmers compared to prices paid by milk hawkers who would buy milk from urban/peri-urban farmers and sell directly to consumers in the city. Consequently, a large informal market unregulated by authorities, estimated by the FAO at 1/3 of the liquid milk market in Addis Ababa, had developed.

While promotion of commercial dairy production around Addis Ababa was going on, attempts were also made to improve dairy production of smallholder farmers in selected parts of the country through a number of agricultural development projects. Prominent among these are Swedish International Development Agency supported Chilalo Agricultural Development Unit (CADU) initiated in 1967 in the Arsi region, and the Wolaita Agricultural Development Unit (WADU) funded by the International Development Association (IDA). Achievements of CADU in the dairy sector include the pioneering of the one-cow-unit dairy development package, in-country production of frozen cattle semen and crossbred dairy heifers, introduction of small-scale milk processing units and AI services to smallholder farmers, and the popularization of forage cultivation. Achievement of WADU include the establishment of the project's farm of 290 dairy cattle, the attempted introduction of AI and bull station services which led to positive attitudinal change to improved dairying, and reduced mortality rate from 17% to 5% due to animal health services. Also livestock was included in the Minimum Package Programme of the extension service of the Ministry of Agriculture initiated in 1972 with IDA funding to expand CADU's dairy development operation to other parts of the country.

Because of all the efforts mentioned above, by 1972, the dairy industry in the Addis Ababa area was well established and growing. As large farms were emerging, surplus intake was occurring at the Shola plant, AI services were established in Shola, and the general quality of animals of small-scale dairy producers gradually improved. By 1972, the DDA was receiving about 21,000 litres of raw milk each day, of which some 57% came from 65 large farms (defined as having 10-250 crossbred cows), the remainder came from smallholders through some 30-collection centres (Staal, 1995). Between 1961 and 1974, milk production from all species increased by 16.6% from 637,375 metric tons to 743,100 metric tons, an average annual growth of 1.63% but per capita milk production declined at an average rate of 0.87% per annum (Table 6). This growth was largely due to economies of scale in production as well as marketing facilities in the Addis Ababa milk shed, subsidies in transport to the formal market, secured land tenure and an active free market for feed and other inputs (Staal et al., 1996).

However, the development projects and extension programmes implemented in other parts of the country made insignificant contribution to dairy output growth. CADU could not be replicated country wide because of the high cost per beneficiary and it accelerated the eviction of the landless tenants as landlords became more aware of the benefits from improved dairying and began to farm themselves. WADU experienced a high staff attrition rate, made more investment in infrastructure than on the extension service, and the project was very capital intensive. The dairy component of the minimum package programme under extension service of the ministry of agriculture was constrained by shortage of animal stock supply.

The Socialist regime (1974-1991)

In 1974, the imperial government was overthrown by the socialist Derg regime, which pursued a range of policies under a centralised economic system. Some of the important policies that directly or indirectly affected the dairy sector are the following:

a) All land was nationalized and distributed to peasants through newly formed Peasant Associations (PA) with only usufruct rights without right to rent, mortgage or sell. Allocated land could be retaken by the PA in order to reallocate to newly formed families. All large farms including dairy farms established under the AADDP and other projects such as CADU and WADU were nationalized or annexed by the PAs. Some large farms were converted into state farms and new state farms were

established. Between 1985 and 1989, 63% of all public expenditures were directed towards state farms.

b) Apart from peasant associations, formation of producers' and service cooperatives was promoted, which changed the nature of agricultural extension work including the services to dairy producers because rather than individuals, producer cooperatives which collectively owned heifers and other supporting inputs were approached as a group (Staal, 1995). Producer Cooperatives had priority in the allocation of good quality grazing land, leaving individual non-member peasants with any remaining poor quality land for communal grazing. It was assumed that state farms and producer cooperatives would have greater capacity to utilize modern technologies and demonstrate greater efficiency deriving from positive economies of scale . The operational procedure of CADU and WADU were changed and inputs and services were distributed to producer cooperatives rather than individual peasant households. New donor funded dairy projects did not start coming again until the mid-1980s, and those that came had the primary objective to support the dairy farms of producers' cooperatives (Ketema, 2000).

c) The DDA and the nationalized dairy farms previously established under the AADDP were merged under the newly established Dairy Development Enterprise (DDE). Operational budget was no longer provided by the government but had to be attained through sales revenues and loans obtained from banks. During 1976-89, 79% of formal sector loan to agriculture went to the state farms though these farms contributed less than 10% of output. Of the total loans disbursed, only 3% went to the livestock sector and bulk of it for draft cattle and beef fattening instead of dairy (Assefa, 1990).

d) With additional assistance of the Government of Finland and the United Nations Capital Development Fund, the processing capacity of the Shola plant was increased to 60,000 litres per day, butter oil recombination capacity was introduced, 30 collection kiosks and 16 chilling centres were established, and milk collection routes were extended to 150 km around Addis Ababa. DDE still had the right to fix price to be paid to raw milk suppliers. Prices paid to producers by DDE increased by only 43% in nominal terms from 1972 to 1992 (0.50 birr/l) favouring the expansion of the informal sector, where the rate of price increase was apparently much higher though exact figures were not available.

e) The government pursued a fixed overvalued foreign exchange rate policy almost throughout its entire reign, consequently export became expensive and import cheaper.

The consequences of these policy changes adversely affected the growth of the dairy industry in Ethiopia for the following 17 years (Ketema, 2000). The rural mixed farming systems which produced the largest share of milk in the country remained largely neglected. According to Staal (1995), dairy policy in the 1980s can be characterized as a severe misdirection of effort. The focus of substantial resources on parastatal institutions yielded little benefit to consumers or producers. Attempts to develop market-oriented dairying in rural PAs were hampered by low producer prices and narrow attention on cooperatives. These same attempts also led to a complete neglect of the informal urban producers, who were the most important for urban milk supply but were forced to seek inputs and services they needed without institutional support.

In spite of huge public expenditures and credit facilities provided to state farms, production from these farms remained stagnant or declined from a high of some 6 million litres in 1983/84 to less than 5 million litres in 1989/90. At that point calf mortality rate in state farms was as high as 38%. All dairy services (technical, plant operations, veterinary, etc) declined rapidly. By 1978, milk intake at the Shola plant had fallen to 3.5 million litres/year from 5.8 million litres/year in 1974. Processing in this plant never exceeded 60% of capacity. In fact, a little above 1/3 of capacity was utilized only because of WFP donations of milk powder, which were reconstituted at the plant. The policy of fixed and over valued exchange rate led to stifled domestic production and cheaper commercial imports in addition to dairy food aid (Von Massow, 1989).

During this period, cooperatives suffered from a loss of credibility by members and the public as cooperatives were turned into government and political tools rather than instruments for socio-economic development. Members who were forced to form or join the cooperative started to show their dissatisfaction. Members lacked tangible benefits and a role to play, therefore a sense of ownership gradually faded so the cooperatives gradually became non-functional (Ketema, 2000).

Government policies during the period led to dramatic increase in the role of the informal market in urban milk supply and demand. A study on consumer purchases of liquid milk in Addis Ababa between 1984 and 1986 showed that 71% of milk was purchased directly from producers, 14.8% from DDE shops or outlets, 13% from private grocery shops and 2% from itinerant traders (Mbogoh, 1992). Another study in 1986 on producer sales of milk in Addis Ababa and surrounding areas showed that most large urban and peri-urban producers sold milk directly to various institutions e.g. hospitals, schools, armed forces, coffee houses, hotels and restaurants in order to reduce marketing and transaction costs. On the other hand, small rural producers having access to DDE milk collection centres chose to sell most of their milk to this outlet due to lower marketing and transaction cost and year round access even though prices were on average lower than in the local market (Debrah, 1992). Hurissa (1998) found that 53% of intra-urban producers sold milk at their farm gates, while 33% and 14% respectively delivered to customers' homes and used both methods of distribution.

Although informal urban producers were supplying 70% of the urban liquid milk demand, they received little, if any, assistance (AI, veterinary services, feed quotas, etc.) as urban areas contained no PAs or cooperatives to channel assistance, and informal urban producers were not officially recognized to exist (Pronk and Tuinenberg, 1998). The growing importance of the informal market

resulted in a major supply shift from peri-urban landholders to urban backyard producers, who purchased feed from peri-urban areas. Driving this process was insecure land tenure. During the period in which land was claimed by the state and farms were annexed by the PAs, the number of crossbred cattle held by urban backyard producers increased. Milk production thus shifted away from the rural feed base to near the urban consumers, and bypassed the formal milk collection and marketing system, which remained, geared towards the rural areas around Addis Ababa (Staal, 1995). The rest of the countryside remained largely unattended.

In 1990, given the world's economic prospects, the Derg regime revised its own policies and adopted a policy of mixed economy. Due to the failure of socialized agriculture, producer cooperatives were reorganized by giving them the opportunity to act in a democratic manner and vote to stay together or not. The result of this was that 95 percent of producer cooperatives disintegrated within 3 months of the announcement (Alemayehu, 1992). Collective property was either divided between members or sold, and in this way, a large number of crossbred dairy cattle came into the hands of small private producers in the urban areas (Gizaw and Amare, 1992). Dairy Rehabilitation and Development programme and extension programme then had to revise their programmes to serve individually owned dairy farms with one and two cows rather than the cooperatives (Ketema, 2000; MoA, 1994).

Democratic government and market reform policies (1991-present)

In 1991, the Ethiopian People's Revolutionary Democratic Front (EPRDF) came to power and implemented several macroeconomic policy changes, e.g. the fixed exchange rate system was changed to a more market determined system, the local currency was devalued significantly in 1992 followed by a series of smaller devaluations which discouraged imports including dairy products. A new land policy was declared in which land remained a national property but usufruct was made tenable for indefinite period with rights to transfer to children; selling and mortgaging remained prohibited but temporary leasing was allowed.

During the initial transition period, service cooperatives were looted, peasants forcibly repossessed communal property, and cattle breeding ranches had large parts of their land repossessed by PAs (Alemayehu, 1992). During 1990-92, the milk supply systems rapidly collapsed due to the increased insecurity, culminating in the collapse of the regime, and subsequent paralysis and uncertainty among official institutions (Staal, 1995). Subsequent dairy development strategy formulated during this period focused on creating an environment for greater smallholder dairy farmers' access to market to meet market demand, so that the producers will be stimulated gradually to produce more to satisfy the market (Tsehay Redda, 2001).

The only official body dealing with dairy policies during this period was the Dairy Development Advisory Board, whose sole task was the allocation of WFP milk powder generated funds towards dairy development. Financial support used to go primarily towards forage development, expansion of veterinary and AI services, and the supply of feeds and veterinary inputs (Staal, 1995). In 1993, the DDE was taken back under government control but was given more management autonomy to make it more efficient, profitable and financially self-supporting (Yigezu, 2000). Of the 14 large dairy farms run by DDE, 12 were returned to their previous owners or sold out. These farms have now expanded their activities including self-processing of milk. As a result of policy change to allow private sector investment in dairy production, processing and marketing, several small and medium scale dairy processing industries have been established around Addis Ababa and other urban areas. These firms use milk from own production as well as collect milk from producers.

The DDE retained its role as the primary actor in the dairy market. In 1993, intake at the Shola plant was 1/6 of capacity. Since then, official prices paid to producers were progressively raised, reaching 1.50 birr/l in 2003. The entrance of Sebeta Agro-Industry, a private dairy processing firm, in the late 1990s offering producers up to 2.00 birr/l of raw milk has stimulated competition and helped expand the formal market. This has caused many peri-urban producers to stop supplying the DDE. Though the administratively set prices paid to producers have been raised, the informal sector continues to dominate the market accounting for about 80% of the milk market in the Addis Ababa milk shed (Staal, 1997). Thus, the move towards deregulation had a similar effect in Ethiopia as in Kenya about the same time although the two countries were not fully and directly comparable because of historical differences in the evolution and structure of the dairy industry and related policies.

To take advantage of the newly created market opportunities as a result of the economic reform measures, prominent dairy producers within a 100 km radius of Addis Ababa formed the Addis Ababa Dairy Producers Association (AADPA). By the end of 1992, 90% of all urban dairy producers enlisted. The main objective was the procurement of cattle feed rather than milk collection. The rural cooperatives were re-built giving attention to human capital (whose role would be to serve and not to govern) because of the lesson learned from the past of the undesirable role of the government in co-op affairs. A new proclamation in 1998 further helped to promote cooperatives of a new kind by liberalizing co-ops from direct government control to an advisory role. However, these multipurpose cooperatives were still primarily engaged in crop activities and input supplies for members and dairy was not yet a major activity, therefore had minor role in the milk market – formal or informal.

Among the development projects, FINNIDA implemented the Smallholder Dairy Development Pilot Project (SDDP) with additional funding from FAO and WFP covering two woredas during1991-

1994 and 16 more woredas during 1995-2000. Identifying marketing as the major constraint for dairy development, the SDDP organized small milk processing and marketing units to raise income and nutritional standard of smallholder farmers through improved dairying. About 30 cooperatives were formed in the peri-urban areas of Addis Ababa. Due to input limitations, the project had to reduce the number of contract farmers from 1000 to 500.

In addition to these focused projects, general improvement in veterinary services, breeding services including artificial insemination, and promotion of forage and feed production through the general extension service has also been observed. For example, between 1984-85 and 1999-2000, a total of 351,032 inseminations were carried out through the artificial insemination networks throughout the country, but most of them in the Addis Ababa milk shed (Figure 13). About 75% of the semen came from Frisian cattle, about 20% from Jersey and the remainder from other breeds. An average of three inseminations were required per conception due to problems on both supply side (untimely delivery, poor quality of semen etc) and demand side (inability to detect heat in time, delayed insemination due to long distance) so the actual number of calves born due to AI was about one third the number of inseminations made (Feleke and Geda, 2001).

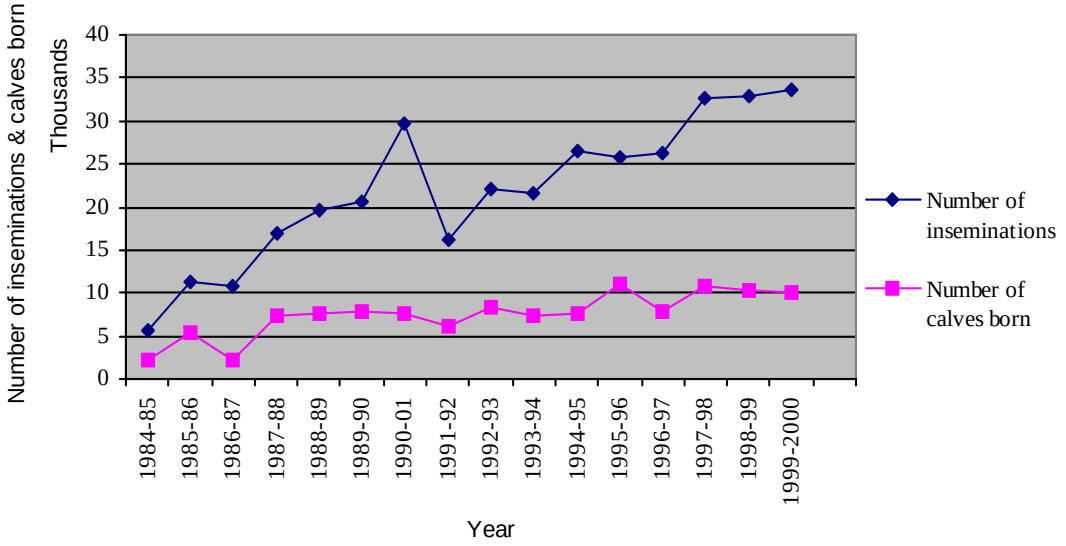


Figure 13. Number of artificial inseminations carried out and calves born in Ethiopia, 1984-2000

Source: Feleke and Geda, 2001

Overall, policy changes during this period were successful in reinvigorating a dairy sector that was gravely affected by the socialist regime. Macroeconomic policies, changes in cooperative legislation, and the openness of the manufacturing sector to private investment all resulted in positive changes giving growth in the dairy sector a new impulse in both the peri-urban areas where most development projects are located and in rural areas where mixed farming is practiced. Although the results obtained by the sector so far are positive when compared to the past (Table 6), the historical performance of the dairy sector in Ethiopia has been disappointing given the potential the sector is assumed to have or if it is compared with countries in the region like Kenya and Sudan

Explaining Regional Differences in Dairy Sector Performance

It was mentioned earlier that dairy development efforts in the country were concentrated in the highlands, especially around Addis Ababa, so differential growth across geographical areas would be expected due to differences in production environment, infrastructure and other factors that facilitate or hinder growth. In the absence of suitable time series data at lower administrative

levels, e.g. woreda, the analysis of regional differences was conducted using cross-section data from a livestock survey carried out in 2001-2002 by the Central Statistical Authority of Ethiopia (CSA, 2003). Data were available at zone level for 43 zones in all the regions except for Mekele in Tigray region and two zones (Godere and Zone 3) in Gambella region. Information was collected on demography, agricultural resources, production systems and practices, input use and outputs and sales for different enterprises. For this study two aspects are considered: differences in dairy production and marketing are explained by descriptive statistics of production and marketed patterns, and differences in the degree of commercialisation of dairy is explained by using a regression with appropriate variables to be discussed later.

Regional differences in dairy production and marketing

There is virtually no reliable estimate of milk production under different production systems over time for different regions. FAOSTAT database only gives national figures. According to a survey by the CSA (2003), 9.3 million milking cows produced an estimated 2590 million litres of milk in 2001-2002 giving an average yield of 278 litres per cow per year. However, FAOSTAT database shows that 7.3 million milking cows produced 1450 million tons of milk in 2001. The FAO estimate is close to the CSA estimates of milk consumption from their household income and expenditure survey (CSA 1997 and 2001), which shows that total consumption of dairy products (in milk equivalents) amounted to 1376 million litres in 1995-1996 and of 1185 million litres in 1999-2000. Since FAO data is not available at regional level, for the purposes of this study, the regional figures of the CSA survey have been adjusted proportionally using FAO estimate of total output (Table 8). For regional comparisons, Amhara and Oromia regions are divided into sub-regions in order to capture variability within an extensive area. Milk production in Somali and Afar regions are not included in the comparison given that information in the CSA (2003) survey for these regions is not complete.

The regional distribution shows that 20% of total output is produced in SNNPR followed by the zones in Oromia and Amhara surrounding Addis Ababa and other zones in Oromia and Amhara, all of them with shares between 10 and 15 percent of total output. This distribution of output roughly follows dairy cow population shares of the different regions, indicating that production and consumption are local as expected given economic development and income, infrastructure, urbanization and geographic distribution of population. The only exception to this is the region comprising the capital Addis Ababa, which is supplied by producers in neighbouring zones. In any case, the impact of Addis Ababa's market on these zones is not evident at this level of aggregation.

Yields are significantly higher in Addis Ababa due to the high incidence of crossbred and exotic cattle but variation between other regions is not high. Hybrid and exotic cows represent only 1.8% of total milking cows in Ethiopia but 47% in Addis Ababa (Table 8). This is a result of the past and present policy of promotion of exotic blood in and around Addis Ababa, and the recognition by producers that these breeds are most economically suited to highland intensive urban production. This explains higher yields per milking cow in Addis Ababa. Areas in central Amhara and Eastern Oromia regions around Addis Ababa and between Addis and Dire Dawa show hybrid and exotic cows above the average for the country but below 2% in all cases, so have no significant impact on yields and total output of these sub-regions. Gambella and Benishangul, showing a small proportion of total milk production have slightly higher yields than other regions.

Table 8. Milk production, milking cows and yields in Ethiopia, 2003

Regions/ Sub-regions	Milking cow (000 heads)	% total cows hybrid & exotic	% milking cows hybrid & exotic	Milk production (mill.liters)	Yield (kgs/cow/ year)
Tigray	483	0.36	1.0	82	170
N.W.Amhara	921	0.23	0.7	145	157
C.Amhara	846	0.57	1.3	128	151
W.Oromia	418	0.01	0.0	63	151
C.Oromia	729	0.10	0.1	111	152

Addis surroundings	1270	1.86	4.5	205	161
E.Oromia	1104	1.48	3.5	199	180
S.E.Oromia	876	0.15	0.4	135	154
Benishagul	63	0.00	0.0	12	192
SNNPR	1614	0.61	1.1	277	172
Gambella	34	0.00	0.0	8	232
Harari	9	0.46	1.0	2	200
Dire Dawa	19	0.73	2.1	3	146
Addis Ababa	20	18.99	46.6	7	362
Total/Avg	8406	0.79	1.8	1376	164

Note: Production figures are based on household and expenditure survey 1995-1996 (CSA,1997) adjusted proportionally using FAOSTAT data for total production.
Source: CSA 2003

On average, 78% of all milk produced in the country is consumed by producing households, and only 22% goes to the market (Figure 14). In Dire Dawa and Harar about 40% of output is marketed while in Addis and its surroundings about 30% of a much larger volume of output is marketed. In most regions, close to 50% of total milk consumed by the producer household is consumed as fluid milk and 30% as butter, the remainder in other forms such as fresh cheese and yoghurt . Households producing milk in urban areas and also in zones in East and Southeast Oromia consume significantly lower amounts of butter. On average for Ethiopia, 53% of total milk sold by producers is sold as fluid milk while 42% is sold as butter with considerable regional variation in these proportions. In urban areas and in East and Southeast Oromia, most of the milk is sold as fluid milk. Butter is the main commercial product in Central Amhara, West and Central Oromia and also in the zones around Addis Ababa, Tigray and SNNRP.

Determinants of regional differences in dairy commercialisation

A regression analysis was done using level of milk sales per agricultural population as the main indicator of commercialization of the dairy sector[2]. This approach was also used in the regional analysis presented in part I of the study. Three different dependent variables were considered: total milk sales, sales of fluid milk and sales of cheese and butter per capita of agricultural population. The explanatory variables are grouped into the following categories as follows;

Crop production: cereal production per rural population, production of other crops per rural population

Agricultural systems: % households in livestock systems, % households in mixed systems, % households in crop systems (base system)

Crop and livestock technology: proportion of crop area irrigated, number of exotic and hybrid cows, number of vaccinate animals, % of cereal seed improved, improved fodder as percent of green fodder,

Market access and urbanisation: % urban population, population density, road density, distance to Addis Ababa, % households access to credit

Human capital: literacy rate

[2] The variable 'milk sales per agricultural population' also accounts for butter and cheese sales converted to milk equivalents.

Regional dummy : which takes a value of 1 when the zone belongs to a particular region and 0 otherwise. Each region is compared with the average of all regions instead of a specific base region. While interpreting results, it should be noted that some of the variables have direct relationship with milk production sales while others are proxies so explain milk sales indirectly. Estimates use a heteroskedasticity-consistent covariance matrix. Because of the small sample size, significance levels for estimated coefficients have been shown only up to 5% level.

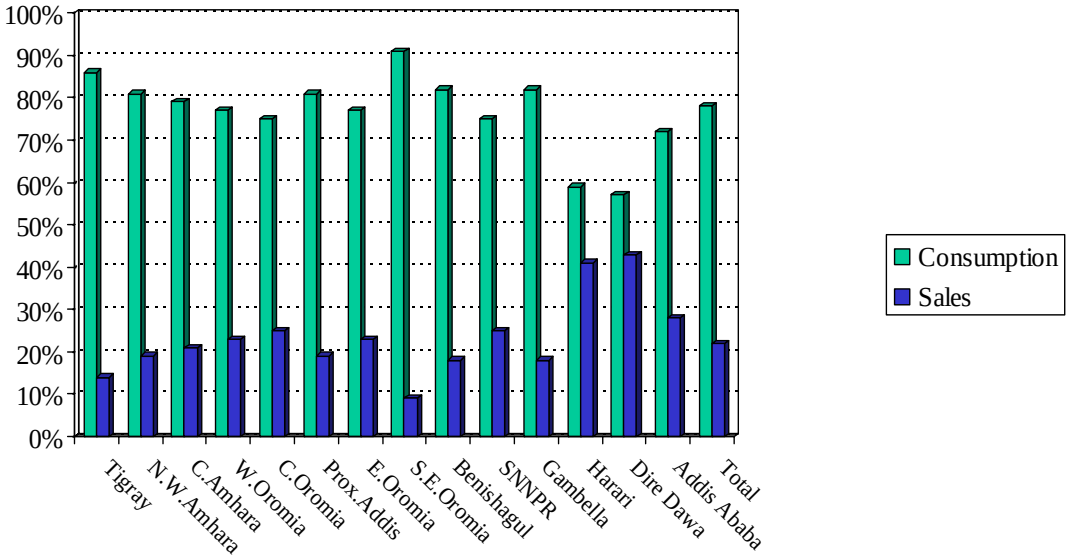


Figure 14. Milk consumption and sales in different regions (2001)

Source: CSA 2003

The regression results show that total milk sales per capita was significantly higher in regions with higher percentage of population in livestock and mixed farming systems, but significantly lower in regions with higher percentage of urban population and higher rate of literacy. This could be explained by the fact that specialisation in livestock leads to higher output leading to higher sales. The negative effect urbanisation and literacy appear to be counter intuitive as urbanisation and literacy usually lead to higher income and higher demand for milk requiring higher milk sales but the negative result may be explained partly by the form of milk sales rather than milk sales per sae (see below). Among the regions, total milk sales were significantly higher in west and central Oromiya and Gambella regions but significantly lower in Northwest Amhara region compared to the average for all regions. Differences for the other regions from the average were not significant.

Regression results show significant differences between determinants of sales of fluid milk and those of butter and cheese (Table 4). Larger sales of fluid milk per capita of agricultural population are associated with high cereal production per capita and high population density. [3] On the

[3] These relationships between cereal productivity and dairy growth is consistent with our findings from South Asia, especially India and Pakistan, where significant take-off in dairy growth was preceded by a period of green revolution technology based cereal productivity growth that generated sufficient income to enhance demand for livestock products and also released land and feed resources for reallocation to dairy animals. Rudimentary evidence of this pattern is also observed in Ethiopia. A survey of 98 villages in the Amhara region in 1999-2000 showed that irrigated crop production is pretty minor but in villages where a

other hand, sales of butter and cheese per capita are not significantly related with crop production per capita and population density. Instead, there is a positive relationship between the dependent variable and the share of farms engaged in mixed crop-livestock and only livestock production. Distance to Addis Ababa is not significant in any of the regressions.

higher proportion of land is irrigated, adoption of improved livestock technologies (improved breeds, artificial insemination, feeds and veterinary inputs) is also higher (Benin et al., 2003)

Table 4. Estimated coefficients of regression on milk sales using three different dependent variables

	Total milk sales (Adj. R^2 = 0.60)	Fluid milk sales (Adj. R^2 = 0.30)	Butter & cheese sales (Adj. R^2 = 0.56)
	Estimated Coefficient[a]	Estimated Coefficient	Estimated Coefficient
Crop production			
Cereal production/rural pop.	0.224	2.225**	-0.154
Production of other crops/rural pop.	-0.030	-0.043	-0.028
Production systems (base= crop system)			
% households in livestock systems	0.989**	-0.807	1.401**
% households in mixed systems	4.058**	-1.944	5.222**
Crop and livestock technology	0.411	-0.067	0.137
Irrigated area/crop area			
Length of growing period	0.616	2.091	0.631
No. of hybrid & exotic cows	0.026	0.110	-0.021
No. of vaccinated animals	0.142	0.622	0.339
Improved feed/green fodder	-0.049	0.135	0.008
Improved seed	-0.087	0.079	-0.083
Market access and urbanisation			
% household access to credit	-0.111	-0.245	-0.013
% Urban population	-0.155**	0.017	-0.157**
Distance to Addis Ababa	-0.087	1.455	-0.510
Population density	0.480	2.889**	-0.204
Road density	-0.150	0.402	0.217
Human capital			
Literacy rate	-1.223*	-3.744**	-1.129
Region dummy			
Tigray	-0.154	0.942	0.817
North West Amhara [b/]	-1.139**	-2.997**	-0.424
Central Amhara [c/]	-0.589	-2.399**	0.233
West Oromia [d/]	1.338**	1.179	1.871**
Central Oromia [e/]	0.676**	-0.289	1.011**
Zones around Addis [f/]	-0.301	-0.448	-0.143
East Oromia [g/]	-0.209	0.840	-0.583
South East Oromia [h/]	-0.480	3.142**	-1.438**
Benishagul	-0.404	-1.161	0.194
Southern Nationalities	0.373	0.515	0.742
Gambella	0.832*	2.828**	0.600
Constant [i/]	10.625**	-4.585	12.800**

a/ Standard errors or p values are not shown to save space. Significance levels are indicated. ** and * respectively indicate significant at 1 and 5 per cent level respectively.
b/ North Gonder, South Gonder, Wag Hemera, Agew Awi, West Gojam and Bahir Dar
c/ North Wollo, South Wollo, East Gojam and Amhara's Oromia
d/ West Wollega, Illubabur e/ East Wollega, Jimma
f/ North Shewa (Amhara), West, North and East Shewa (Oromia)
g/ Arsi, West and East Harerge h/ Bale and Borena
i/ Constant term represents the mean of all regions and the coefficient for each region represents differences with the mean

One possible interpretation of these results is that sales of fluid milk are related with relative development of cereal production and high population density in regional markets, with no effect of Addis Ababa's fluid milk market on these regional milksheds because of the long physical distance of the Addis market. Fluid milk sales would be higher where higher population densities reduce transport and transaction costs and facilitate development of local markets. On the other hand, sales of butter and cheese are directly related to production systems capable of generating surplus milk, which are processed and then sold in local markets though Addis Ababa's market is one of the main final destinations. Since all zones target Addis market for butter to some degree, distance to Addis appears to have a neutral effect on the sales of butter in a zone. In this case, the larger the proportion of the population engaged in specialized crop production systems in a particular zone, and the larger the urban population in this zone, the smaller the volume of butter and cheese sales per person in that region. According to this, urbanization's negative effect on butter sales could be related to a positive impact of this variable on sales of fluid milk (positive but not significant in the second regression) and hence indirectly reducing sales of processed products.

Regional effects, captured by dummy variables, are relatively unimportant. Only two regions – Southeast Oromiya and Gambella- show significantly higher fluid milk sales per capita compared to the average and two others regions – Northwest and Central Amhara – show significantly lower fluid milk sales compared to the average. In case of butter and cheese, Oromia to the west of Addis Ababa appears to have higher sales per capita, and Southeast Oromiya have significantly lower sales, ceteris paribus.

Literacy of the population shows a negative relationship with fluid milk and butter and cheese sales. As an indicator of human capital, literacy is normally related to innovation capacity when it refers directly to the dairy producer or the household members. In this case, literacy refers to all population in a particular zone and the negative response of milk sales to literacy could be related to the fact that zones with higher literacy rates develop other activities (probably non-agriculture activities) negatively affecting milk production and sales in that particular zone.

The effect of urbanization appears to be positive but not significant when explaining sales of fluid milk but negative and significant in the case of sales of butter and cheese. Differences in the degree of urbanization across regions are also not very pronounced.

Income and Employment Opportunities in Milk production, Processing and Marketing

Employment and income from dairy will vary between and within production systems because of differences in feed sources, management, herd sizes, form of milk disposal patterns etc. A comparison of employment and income from all dairy related activities for two groups of farms from the highlands – one having crossbred cows and another with local cows –are shown in Table 9. Both groups have an average of two cows, two oxen, a horse or donkey and number of sheep and chicken. These two groups may be taken as representative of the small peri-urban and rural mixed systems respectively. Share of dairy has been calculated based on detailed daily data records.

Traditional small-holder mixed farming systems generate several times more employment but low income per unit of milk produced compared to urban/peri-urban dairy systems because of low productivity of animals in the former. In both the systems, over two third of labour is provided by children because they usually do the herding. Not much women labour is used in production activities but they are primarily involved in traditional processing and marketing (see below).
Extrapolating the labour requirement figures per 1000 litres of milk produced to the systems level, the urban/peri-urban system, which produce 205 million litres of milk annually, create annually 4.428 million person days of work or 14760 full time employment assuming a 300 day work duration. The figure increases to 16400 full time employment if 270 day work per year is assumed. The small-scale mixed farming system, which produce 900 million litres of milk annually, can create 166.050 million person days of work equivalent to 553,500 full time job at 300 day work per year or 615,000 jobs assuming 270 day work duration. Employment figures for the pastoral livestock system, which produces 320 million litres of milk could not be calculated due to lack of information.

Table 9. Employment and income on dairy farms in Ethiopia

		Farms with crossbred cows (small scale peri-urban system)	Farms with local cows (Traditional small-holder mixed farming systems)
Aggregate quantity of milk produced on a daily basis (Litres)		561,644	2,465,753
Rate of employment generation (Fulltime jobs /1000L produced on a daily basis)	Total employment	26.3	224.5
	Family labour	17.3	159.6
	Hired	9.0	64.9
Total employment generated (Fulltime jobs)	Total employment	14,760	553,500
	Family labour	9,697	393,539
	Hired	5,063	159,962
Income	(Birr/household/year)	1,908	168
	(US$/household/year)	281	25

a. Child labour has not been converted to adult equivalents as children do grazing and related activities as efficiently as adults. Source: Shapiro et al. (2000); Tangka et al. (2002) and authors' own calculation.

Only a small amount of milk is processed into pasteurized milk, butter and cheese by large-scale commercial processors. Most of the milk produced in the country is processed by the producers themselves on-farm into butter and soft cheese (*ayib*) for home consumption and sale. Rural producers far away from urban markets usually process surplus milk into butter because of difficulties in selling fresh milk locally, and strong demand for butter in markets in the towns and cities.

To estimate labour use for on-farm rural processing, previous farm surveys conducted in the highlands by O'Mahony and Bekele (1985) have been used.

For large scale industrial processing sector, data were obtained from two industrial processors both located in or close to the capital, Addis Ababa: Sebeta Agro-Industry (Mama Milk) and Dairy Development Enterprise (DDE). These plants process about 9 million litres of milk per year and supply products to small shops and supermarkets in Addis Ababa. For other commercial processors in urban and semi-urban case study survey of small, medium and large processors was conducted in Central and Western Ethiopia during the first semester of 2004.

Extrapolating the results of these surveys and secondary data to the national level, potential employment and income from dairy processing and marketing are summarized in Table 10. In general, there is an inverse relationship between scale of operation of business and jobs per 1000 litres of milk processed daily but income per worker increases as the scale of operation or business increase. Overall, labour use in various dairy processing and marketing activities in different production systems and scales of operation total an equivalent of 174,000 full time jobs. Of this, on-farm processing and marketing generate 94% of the daily employment because commercial processing is still at rudimentary stage in the country. And nearly all on-farm processing and sale is conducted by women. As processing moves beyond farm and scale increases, share of female labour in processing declines.

Table 10. Employment and income generation through milk processing and marketing in Ethiopia

Milk processing		**Farm household**	**Small scale processor**	**Medium scale commercial**	**Large industrial**	**Total**
Market share	Milk quantity handled (L/day)	2,155,616	5,740	7,800	25,200	2,194,356
	Percentage	98.2	0.3	0.4	1.1	100
Rate of employment generation	(Full time jobs/ 1000L)	26	167	23	17	26
Total employment generated	Number of fulltime jobs	55,987	1,009	179	435	57,610
	% employed by category of processor	97.2	1.8	0.3	0.7	100
	% of female workers	98	26	50	19	na
Income	Birr/worker/yr	na	1640	2700	6324	na
	US$/worker/yr	na	190	314	735	na
Milk trade		**Farm household**	**Small trader**	**Medium trader**	**Large trader**	**Total**
Market share	Milk quantity handled (L/day)	197,260	49,381	12,345		258,986
	Percentage	76	19	5	n.a	100
Rate of employment generation	(Full time jobs/ 1000L)	188	107	88	n.a.	167
Total employment created	Number of fulltime jobs	36,986	5,291	1,058	n.a	43,335
	% employed by type of trader	85	12	3		100
	% female labour	na	72	59	19	na
Income	Birr/worker/yr	na	2,530	2,550	n.a.	n.a.
	US$/worker/yr	na	294	297	n.a.	n.a.
.Butter trade		**Farm household**	**Small trader**	**Medium trader**	**Large trader**	**Total**
Market share	Volume of butter (milk equivalent/day)	816,435	413,700	330,960	82,740	1,643,835
	Percentage	50	25	20	5	100
Rate of employment	(Full time jobs/ 1000L)	88	2.27	1.38	0.36	44
Total employment created	Number of fulltime jobs	71438	940	456	30	72,865
	% employed by type of trader	98.0	1.3	0.6	0.1	100
	% female labour	100	100	0	0	na
Income	Birr/worker/yr	na	1020	4110	4430	na
	US$/worker/yr	na	119	478	515	na
Full time jobs		164,311	7,240	1,693	465	173,810
% employed by type of trader		94.5	4.2	0.97	0.33	100

Source: O'Mahony and Bekele (1985) and field survey 2004.

Main Lessons from Ethiopian Dairy Development

Identification of effects of key factors and policies on dairy development trends

Ethiopian rural economy is dominated by smallholder crop-livestock mixed farms, yet the main thrust of dairy development policies of successive regimes over the last half century has been on improving commercial dairy production in selected areas of the country, especially around Addis Ababa, by promoting crossbred and exotic cows and related feed and management technologies, and development of a milk processing industry to supply the Addis Ababa market. However, these development efforts made insignificant impact on the growth of the sector as a whole and even in the areas where these have been implemented. Out of a total of 9 million dairy cows in the country (including about 7 million milking cows), there are only about 300,000 or 0.3% crossbred or grade cattle, most of them are located around Addis Ababa (Ejigu, 2003). The exact exotic blood levels of these animals are also not known. Only 4 percent of total milk consumed in the country is pasteurized.

This poor performance is partly because of low income and low demand on the one hand and supply side constraints on the other. Generally the poor performance of Ethiopia's dairy sector in the past is attributed to socioeconomic, infrastructure, and technical constraints, inadequate research and extension in livestock compared to crop, and lack of direction and scope of policies related to dairy (Gebrewold 2000). The most common constraint noted being land tenure policies, feed availability, lack of animal services, breeds of cattle used, lack of marketing outlets, roads and transportation. Felleke (2001) argues that there is no livestock breeding and dairy development strategy in the country, except the draft policy incorporated in the general agricultural policy and the draft breeding policy of 1986 not yet finalized. Past dairy development efforts were based on projects related to purpose and area specific dairy strategies without any national policy aimed at setting out comprehensive dairy development strategy and programmes.

However, there is general consensus that the most important reason for poor performance has been the policies and policy instruments pursued by various regimes, most notably during the centralized economic systems of the Derg (1974-1991), which stalled progress and stifled it further. The policy of introduction of an inappropriate technology package for improving productivity under the poor economic and infrastructural environment of the country to serve the urban market also did not work. In a low income country with low consumption of dairy products and where more than 80 percent of the market corresponds to butter and raw milk, the impact of these policies ought to be very limited. Politicisation of the cooperatives also distorted and stifled the limited role it could play in promoting production and marketing. The main outcome of these policies is an established dairy processing industry with a private firm increasing its share in the Addis Ababa market. This firm is capitalizing on previous developments and policies implemented by the government to supply the government owned plant, which has been affected by the competition reducing its share in the market and operating only at a fraction of its capacity.

These policies did not result in benefits for consumers and benefited only a small group of producers supplying the manufacturing plants. The impact of these policies cannot even be detected at an aggregate level in the Oromia and Amhara regions close to Addis Ababa. Fluid milk sales are a regional phenomenon not related with Addis Ababa's market but mainly determined by feed availability (cereal production per capita) and population density. There is some evidence to suggest that where improved cereal production technology has been adopted, better livestock technologies are also being adopted resulting in better productivity and higher marketed surplus of milk. Addis Ababa appears to have some influence as a regional market for milk surpluses processed as butter and cheese by producers in mixed and livestock production systems, at least in those zones closer to the capital (informal market). However, introduction of economic and market reform measures since 1992 and promotion of other supporting services, e.g. veterinary services, artificial insemination, have started creating positive impacts on the sector, especially in the peri-urban areas.

Looking at the historical data, and considering the key role that domestic demand had played in the development of dairy sector in other poor countries, we conclude that demand had played an important role constraining growth of the dairy sector in Ethiopia. Consumption per capita is low due to consumer preferences and low income. Total growth of GDP per capita between 1961 and 1999 was 17 percent (or 0.4 % per year) compared to 56 and 37 percent growth in Kenya and Sudan respectively.

With such demand constraint, it is not surprising that changes on the supply side were very limited and almost confined in and around Addis Ababa market. Improved technology in production and processing did not spread much beyond Addis Ababa milk shed due to the small size of the market. As shown by de Janvry and Sadoulet (2001), technical change in a sector selling marketable surpluses in the domestic market would result in sharp decreases of output prices with no gains in income for producers, except for those resulting from increased home consumption. If this is the case, the explanations of lack of development of the sector based on supply constraints cannot be sustained.

Growth of the dairy sector could be constrained by low demand and low prices and/or by high transaction costs, which reduce the actual price received by producers and their incentive to generate

surpluses. Milk is mainly produced for household consumption and any surplus is taken to the market provided the price received compensates the effort (the opportunity cost) to take that surplus to the market. Production costs and technology don't play any role in this decision. The higher the price received and the lower the cost of selling that milk the higher the incentive to take more milk to the market. This interpretation may be further supported by the fact that milk consumption per capita decreased between 1995-96 and 1999-2000 according to the CSA's household expenditure survey (CSA 1997 and 2001) although GDP per capita increased at an average annual rate of 3.3 percent between 1993 and 1999 according to World Bank data. Assuming that income elasticity for dairy products is greater than zero (probably greater than 1), demand should have grown during this period, but consumption decreased. The reason for this apparent anomaly may be that there is a market failure in the dairy sector and that the main constraints to its expansion at present are related to market development and marketing. The market failure would imply that prices for dairy products are too high for consumers, at least for some, and too low for producers, which could explain why aggregate consumption decreases with income growth, and why a growing demand is not reflected in prices and does not result in increased supply. This is normally the case when high transaction costs exist.

Identification of effects of trends, key factors and policies on the poor

Politico-economic philosophies and related policies pursued by three successive regimes is the over-riding factor responsible for relative stagnation and endemic poverty in the country. For that reason, the problems and opportunities in dairy production and marketing in the country is no different from the general problems of its agriculture in general because most of the producers are small-scale mixed farmers. The policy of improving commercial dairy production in selected areas of the country, especially around Addis Ababa, by promoting crossbred and exotic cows and related feed and management technologies, and development of a milk processing industry to supply the Addis Ababa market, benefited a small number producers in the urban/peri-urban areas, but created little impact on rural dairy producers. Cooperatives could not play its proper role in promoting smallholder production and marketing because there was little incentive on the part of the small producers to do so. Dairy production for majority of the poor small farmers remains a minor activity to complement crop production. Large amount of labour is used in raising animals by traditional smallholders, and much of this is provided by children who can't afford to attend school due to poverty. But because of low productivity of the animals raised, little income and marketable surplus is generated. On-farm processing of milk into butter and cheese is the responsibility of women but inadequate roads and market infrastructure constrain remunerative market access for products, so their return from value added activities remains meagre.

Identification of policy opportunities and entry points

Population and urbanization are growing rapidly. Income growth in the past few years has been modest and may continue at this pace but will still remain very low to create any drastic change in the structure of demand for dairy products. Dairy production will remain primarily at the hands of small-scale mixed farms in the rural areas though the market share of urban/peri-urban systems will increase slowly. Main government efforts to commercialise agriculture will remain focused on the crop sector, which is understandable and in fact desirable, because without a major take off in the crop sector, dairy development efforts focused on the poor, especially in distant rural areas, may face many problems. Given these scenarios

First, promotion of dairy as a tool for poverty alleviation may be fostered by supporting both infrastructural and technological options that will enable small holder farmers and small scale local processors to add value through marketing and processing products demanded by both rural, small urban and city based consumers. Scaling up of processing technology and sizes of firms may gradually evolve with general economic development of the country.

Second, policies should target the development of raw milk and butter markets because these are the products demanded by most of the population in Ethiopia and that pasteurized milk and butter are poor substitutes for these products at the present levels of income. This is why the informal market for these products representing about 90% of milk market kept growing during 40 years of policies focusing on developing industrial processing. Policies to develop the present informal markets should focus on supporting small and medium scale private enterprises in the rural areas and on reducing transaction costs, increasing prices and margins for producers and reducing prices and increasing quality for consumers.

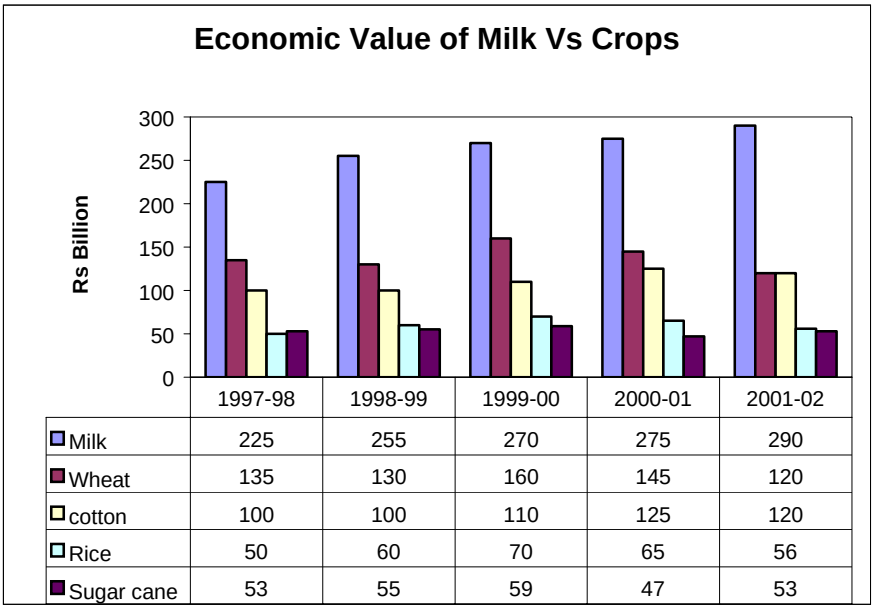
Third, given poor infrastructure and the costs of moving perishable commodities within the country, policies directed to different milk sheds beyond Addis Ababa will be necessary in order to expand the benefits of development of the dairy sector to other areas. Regions in the highlands with high potential for crop production and milk surpluses, and high population density could contribute significantly to the development of the dairy sector. The expansion of green revolution type technology is still limited and constrained by structural problems in the grain marketing systems. Solving the grain marketing problems will also provide greater opportunities to introduce improved technology based livestock production to complement improved crop production but the complementarities of the issues, constraints and opportunities need to be pursued through appropriate research, policy analysis and design of functional projects. Because of the land tenure policy many younger families are landless so they are constrained to raise livestock especially dairy cows due to feed shortage. However, landless and smallholders still raise 1-2 cows by accessing common grazing resources or collecting feeds from various local sources. Because of their need to buy cereals for family consumption, they have high propensity to sell their milk output. As farm size increase and dependence on market for cereal reduce, families tend to consume an increasing share of their milk output. Larger farms with adequate cereal and also feed base to raise more dairy cattle have larger marketable surplus. This production and marketing phenomenon has important implications for development practitioners for targeting technology, credit, input and service delivery, e.g. poorer households may not be suitable for raising crossbred cows but access to credit and appropriate technology may help them get out of poverty by raising local dairy animals.

DAIRY DEVELOPMENT IN PAKISTAN

Khalid Mahmood, Mohammad Jabbar, Zelekawork Paulos

Introduction: Some Dairy Development Trends

A major structural transformation has occurred in the agricultural sector of Pakistan during the last two decades. While the share of agriculture in national gross domestic product (GDP) has declined from 30% in 1980 to 24% in 2002, the contribution of livestock sub-sector to agricultural GDP has increased from 26% in 1980 to 47% in 2002. During 1960-2000, agricultural GDP grew by 3% per annum but livestock sector output grew by 3% until 1980, and by over 5% thereafter. Dairy sub-sector played the most important role in this transformation as milk production increased from 5.4 million metric tons in 1960 to 28 million metric tones in 2000 (Economic Survey of Pakistan, 2002-2003). The relative values of crops and milk products in recent years are shown in Figure 15. Within the livestock sector, dairy (milk) accounts for 66% of the value of output, ruminant meat accounts for13%, poultry meat and eggs 8%, and other products 13% (Agriculture Statistics of Pakistan 2001-2002).



	1997-98	1998-99	1999-00	2000-01	2001-02
Milk	225	255	270	275	290
Wheat	135	130	160	145	120
cotton	100	100	110	125	120
Rice	50	60	70	65	56
Sugar cane	53	55	59	47	53

Figure 15. Values of milk and various crops in Pakistan, 1997-2002

Source: Agricultural Statistics of Pakistan, 2001-02

Annual production of milk increased more rapidly after 1986 due to a combination of changes in dairy population, species composition and yield per animal. Total population of cattle and buffalo, the main sources of milk, increased but buffalo population increased faster than cattle population since the mid 1980s, and so share of milk production from buffalo increased along with increase of total milk production (Table 11, Figure 16). Moreover, milk yield per animal increased at a rapid rate , especially in Punjab province, since the mid 1980s partly because of a larger share of buffalo population and partly due to higher per animal yield from better germplasm supplied through artificial insemination. Per capita milk production slightly decreased between 1960 and 1972 due to slower milk production increase compared to human population growth, but after 1972 per capita production increased initially slowly up to 1986, then quite rapidly.

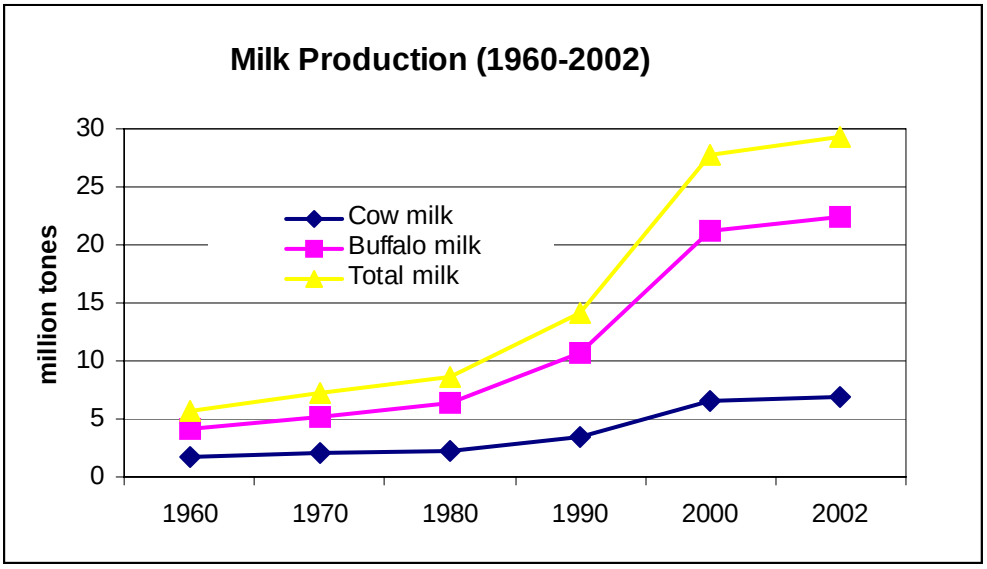


Figure 16. Milk production trends from cattle and buffalo, 1960-2002

Source: FAO and Agricultural Statistics of Pakistan (1960-2002)

Table 11. Buffalo and cattle population, Pakistan 1960-2002 (million heads0

	Buffalo	Cattle
1960	8.2	16.6
1970	8.9	14.5
1980	11.4	13.9
1990	17.7	12.5
2000	22.7	22.0
2002	24.0	22.9

Source: Agriculture statistics of Pakistan, 2001-02

A comparison of household expenditure patterns between 1990 and 2000 shows that in 1990, 21 and 14% of household food expenditures were spent on milk and meat respectively, in 2000 these shares were 23 and 11% respectively but of a higher level of absolute expenditure (**Error! Reference source not found.**). A study in 1987 found price and income elasticity of demand for milk as –0.58 and 0.66 respectively and for meat as –0.80 (Hamid et al., 1987) indicating that milk and meat are highly price and income elastic commodities. With rapid GDP growth, as indicated earlier, there was therefore an increase in the demand for milk.

Pakistan met its demand largely from domestic production as imports have been very marginal and it has decreased over time. For example, import of powdered milk decreased from about 10000 tons in 1990 to about 5000 tons in 2000 due to increased domestic production.

Table 12. Patterns of household expenditure on food, 1990 and 2000

Food items	% of 1990 expenditure	% of 2000 expenditure
Cereals	13	14
Milk	21	23
Meat	14	11
Pulses	18	21
Vegetables	14	9

Vegetable oil	10	12
Others	10	10
All	100	100

Source: Federal Bureau of statistics, 2000

Although milk production increased several times, about 85-90% of milk consumption in both rural and urban areas of Pakistan remained in the form of raw unprocessed milk, and traditional processed milk composed of various milk products, e.g. yoghurt, ghee/butter oil, butter. Raw milk is usually boiled at home. Most of the raw milk and traditional milk products is marketed by farmers themselves in their own localities and by informal traders in urban and rural areas. Consumer demand for processed milk has been increasing slowly since the mid 1990s. Among the processed milk products, 50% is UHT milk, 40% powder milk and 10% consists of pasteurised milk, yoghurt, cheese and other milk products.

The above trends in the dairy sector with respect to production, consumption, trade and marketing patterns have been directly and/or indirectly influenced by different policies, programmes and institutional initiatives taken since the 1960s. Some policy measures remained effective for specific years or period, while others had a longer-term existence, therefore had confounding effects along with other short-term measures effective at the time. Moreover, some policies were focused on specific geographical areas like Punjab and Sindh, the main dairy producing areas of the country, while others had an economy-wide impact. However, the policy measures may be classified into two broad groups:

Policies, institutions and programmes for improving production and marketing of milk:

- Public investment in livestock extension and services
- Promotion of dairy cooperatives
- Targeted dairy development projects
- Public sector investment in milk processing and marketing
- Facilitating private sector investment in dairy processing
- Import tariff on milk powder and income tax exemption to dairy farmers

Other policies indirectly affecting the dairy sector

- Promotion of green revolution technologies
- Exchange rate policies
- Tax policy for processed milk products and agricultural inputs
- Regulations banning animals in metropolitan city areas
- Regulation to control milk quality

In this summary review, it is not intended to quantify the exact effect of these policy measures and related regulations and institutions individually or collectively rather the objective is to indicate their effects or likely effects on the dairy sector growth in a qualitative or logical manner. First, the overall dairy sector growth in the country is discussed with a focus on Punjab and Sindh provinces where appropriate as they are the principal dairy producing areas in the country. Then, differential growth in Punjab and Sindh provinces are discussed in much more detail. Compared to Sindh, Punjab covers a much larger geographical area, has fertile land, is more densely populated and there has been substantial investment in irrigation and other infrastructure which provided a larger and better environment for dairy development. A large part of Sindh is arid and development investment there occurred much later than in Punjab. These differences will partly explain, among other things, the differential performance of the two provinces as will be discussed later.

Policies and Institutions for Improving Dairy Production and Marketing

Public investment in livestock extension and other services

The Federal Ministry of Agriculture, through its Livestock Division, used to provide animal health, breed improvement, artificial insemination (AI) services, extension services, and also create milk processing and marketing infrastructure to promote commercial dairy production and meet urban demand. In 1970, the function was decentralised by creating a Provincial Department of Livestock in each province. The Department of Livestock in the Punjab province has been successful in promoting livestock development through some of the services and technologies while in other cases, there has been insignificant impact.

One of the successful areas of intervention in the Punjab was the provision of AI services. Currently Punjab has AI coverage in all its 34 districts through a network of 750 AI centres and sub-centres operated by 286 AI technicians. There are 4 semen production centres in the province with a total capacity to produce 1.48 million doses of semen annually. As a result of these facilities, AI coverage increased from 15000 inseminations in 1971 to 1.15 million in 2000 (Figure 17). Along with increase in buffalo population, coverage of buffalo population with artificial insemination also increased rapidly. At present only about 10% of breedable animals are inseminated by AI. Average production of these animals is about 25% higher than naturally bred local animals, so productivity

improvement has partly contributed to the dairy sector growth. It is unclear what genetic material or breeds have been promoted through AI services and what affect it had on the genetic composition of the provincial dairy herd- both cattle and buffalo.

Public sector expenditure on research and extension for livestock and dairy development in the Punjab Province increased from about US$16 million in 1988-89 to about US$25 million in 2001-02, an increase of 56% in real terms over a 12 year period. A large share of this budget has been spent for salaries and wage payments and for building and maintaining infrastructure, but a good portion has also been spent on actual research and services that contributed to the growth of the sector. Such detailed figures for Sindh were not available for a comparable analysis.

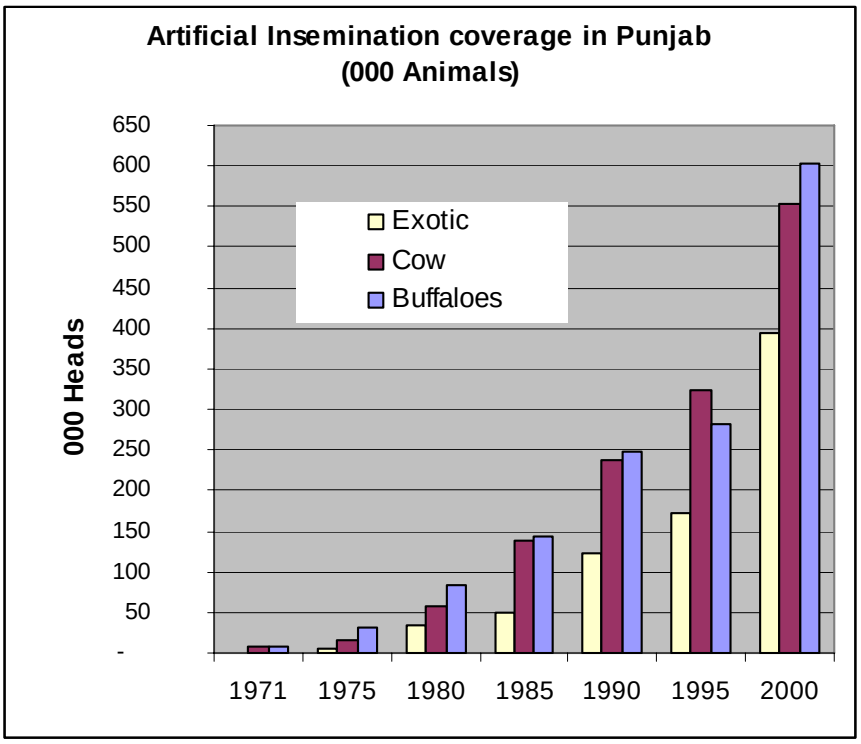


Figure 17. Artificial insemination coverage in Punjab Province, 1971-2000

Source: Livestock Department of Punjab Provincial Government

Promotion of dairy cooperatives

The cooperative movement has a long history in Pakistan since the British colonial rule, though there were few successes with this movement. Special efforts were made since 1965 to organise producer cooperatives to supply agricultural inputs with assistance from a federal cooperative bank. But big landlords captured most of the benefits. Cooperatives apparently did not serve the livestock sector or dairy sub-sector in the beginning. In 1983-84, a dairy development project was started in Pattoki Tehsil of district Okara in Punjab under a joint project run by the Punjab Provincial Livestock Department and the German Technical Cooperation programme (GTZ). The project promoted adoption of improved breeds through AI, improved fodder, health improvement and milk collection and processing for urban market. The cooperative also performed other welfare functions for its members. In 1992, the project was formalised as a farmers' cooperative under the Societies Act of 1980 and was named as Idara-e–Kissan (IK), which then acquired long-term lease of a non-functional government owned milk processing plant near Lahore and another near Pattoki to increase its processing and marketing capacity. Currently, 19,000 farmer members of the cooperative own the enterprise. The society started its development and operational activities from the Halla Union Council, and later used Halla as the trade name of all its milk products.

In the milk collection area of IK, 70-80% of the households are small livestock keepers with an average of 2 dairy animals. In 1992, milk collection covered 87 villages, with about 250 households per village; coverage has increased to 326 villages in 2000 and 400 villages in 2003. Current daily collection is about 200,000 litres through 576 milk collection centres. About 5-10% of milk is collected in the evening. From 1992 to 2000, average annual sales increased from only 4 million litres to 39 million litres. Initially pasteurised milk used to be produced but market was limited as consumers were not yet ready to pay the extra cost of value addition as they were used to the lower

priced traditional liquid milk supply from *gowalas* (milkman or milk retailer) and also from urban dairy farmers. In 1998, IK conducted a limited experiment with supply of open pasteurised milk without packing and selling through small retail milk shops. This policy targeted a segment of the consumers looking for quality but not yet ready to pay for packaging. The strategy succeeded in getting consumer acceptance as price was comparable to raw milk supplied by *gowalas* but quality was better. For example, in December 2003 price per litre of UHT milk was Rs 30 (US$0.50), pasteurised unpacked milk Rs 17 (US$0.28) while raw milk sold by informal traders was Rs 12-18 (US$0.20-0.30). The scheme was multiplied by establishing its own retail milk shops called 'Halla' milk shops or centres. As a result, IK's market share in Lahore increased rapidly.

Currently, daily processing and sales through 450 Halla retail shops are roughly:

- 70,000 litres unpacked pasteurised (open pasteurised)
- 20,000 litres pouch packed pasteurised
- 30,000 litres UHT
- 80,000 litres converted to powder and other products

Largest share of UHT milk is now held by Nestle, a private enterprise (see below), and pasteurised milk by IK. There is seasonal fluctuation in production as raw milk supply increases in the flush season due to better feed availability and drops in the summer. So about 40% of flush season milk collection is converted to powder and sold in the domestic market in the dry season.

IK has recently acquired another government owned milk processing plant owned by the Pakistan Agriculture Research Council near Islamabad and started milk collection from other regions of Punjab on similar pattern of farmer organizations.

Targeted dairy development projects

In the past the federal and provincial governments invested own and/or donor resources in targeted livestock development projects in specific areas of the country with specific objectives to develop the livestock sector. One such project was the Punjab Smallholder Dairy Development Project, which operated from 1991-98. The project was jointly funded by loan from International Fund for Agriculture Development (IFAD)and a grant from United Nations Development Programme (UNDP) at a total cost US$14 million. It targeted 27,000 beneficiaries, focused on poor rural households, in 720 villages in six Tehsils in Gujranwala Division to raise milk production for home consumption and income generation. The Tehsils are : Wazirabad, Hafizabad, Phalia, Kharian, Norowal and Sialkot . The project created village milk collectors to collect and deliver milk to public or private sector owned milk collection centres of existing processing plants in the project areas; built 72 km of farm-to-market roads, helped to connect rural producers with organised marketing channels. The project also contributed to improved cropping pattern, hybrid seed and grass varieties and fodder production

According to an evaluation report of the Punjab Economic Research Institute (PERI), milk production has increased by 26.5% among the targeted households. Milk sales per household increased by up to 69%. The joint mission report of the Asian Development Bank and IFAD explains that milk production in the project area of Gujranwalla division has increased by 15%. The project was incorporated by the Provincial Livestock Department in its regular programme of activities as the results of the project were encouraging. Under this project, different programmes e.g. fodder improvement, animal production and milk marketing, are still functional. The project is planning to register Livestock Farmers Associations under the Cooperative Act, and adopt Bull Mother schemes for improvement of breeds.

Public sector investment in milk processing and marketing

Assuming that there was demand for clean and good quality milk in the urban areas, the government considered that milk processing could bring development in the dairy sector by linking production and consumer demand. So a policy was pursued to create dairy processing and marketing facilities under government ownership and management through some dairy development projects. Punjab Livestock Project is a good example. During the mid 1970s livestock development projects were conceived for increasing milk production. For example, a Livestock Development Project was started in 1975 as an umbrella pilot project in some districts of all four provinces with an investment of Rs 78.37 million of which World Bank loan covered US $10 million (Rs 36.93 Million) and Rs 41.41 million was generated from Punjab government grant and equity fund. Major part of this project investment was made in Punjab in Sheikhupura district. The main objective of the project was to increase milk production by improving productivity of dairy animals through increased semen production for buffalo and cattle, and by improving marketing through establishment of milk plants with UHT technology and selling processed milk. The implementation of the project was delayed by four years due to change in management and delay in installation of machinery that led to the failure in achieving the planned objectives.

Once implemented, it helped in creating capacity to process nearly one million litres of milk per day but consumer preference was not yet geared to accept processed milk. Consequently, capacity utilization was very low and most enterprises ran at heavy losses, e.g. the Lahore milk plant was running at about 32% of its capacity and suffered a loss of Rs 3.12 million in 1984. The Government disinvested these enterprises in the 1990s after the adoption of macroeconomic structural adjustment policies and a different set of policies was pursued to encourage private sector investment in the dairy industry (below).

Facilitating private sector investment in dairy processing

Since the mid 1970s, alongside establishing public sector dairy processing facilities, the government followed a policy to give soft bank loans (low interest, few collateral requirements) to private entrepreneurs in the dairy sector for dairy farming, milk collection and processing; and also allowed duty free import of machinery for the dairy sector not produced domestically. This policy increased private sector investment – both local and multinational - in the sector. The Agricultural Development Bank of Pakistan (ADBP) financed a total of 32 milk-processing plants through this policy. But it created over capacity in the industry in relation to needs and market for processed milk. Although there was no explicit policy to control informal trading, it was hoped that expansion of the formal milk processing and marketing would automatically reduce the importance of the informal sector. However, that has not happened as rapidly as was anticipated or expected, hence only a few of the processing plants are still operational, others closed down due to inadequate milk supply and lack of management skills and market for products. This failure also means that not much impact on dairy production occurred through anticipated backward linkage. Since 1990, the ADBP has changed its policy for the dairy sector and almost abandoned investment in this sector as the bank was left with about Rs 1 Billion in defaulted loans. Instead, the bank has been offering loan only for dairy farming, especially small-scale farming.

Since the mid 1990s, demand for processed milk products has been increasing slowly (Figure 18) and in response private sector investment in dairy processing has again started picking up since 1995 as the UHT technology has proved to be effective in increasing shelf life of milk without cooling, and establishment of milk powder plants has enabled to convert surplus milk in flush season to powder milk for selling in the dry season. One of the most successful dairy processing enterprises in the country is owned by Nestle (Pakistan), a subsidiary of the multinational company Nestle. The enterprise was originally known as Milkpak (a local company), which produced packaging materials for the dairy industry but in 1979 it established a processing plant of its own to produce UHT milk. Currently, it occupies the largest market share of UHT milk in the country. It now collects milk from 130,000 farmers in 3000 villages in the Punjab province. The company owns the biggest milk collection network that collects 1 million litres of milk per day, both in the morning and evening. About 30% of evening milk of the members is collected, and rest of the milk is used by households for family consumption and for making butter oil and other milk products. Like Idara-e-Kissan (IK), the farm services of Nestle is developing milk production belts by providing milk suppliers with extension services and promoting use of good quality feed and breed improvement. The company enjoyed 15% growth in sales over the last five years.

These developments helped to increase overall milk production and to decrease import of powdered milk from about 10,000 tons in 1990 to 5,000 tons in 2000. However, currently there are 44 milk plants in the country with installed capacity of 5 million litres per day but only 13 plants are operational with about 40% capacity utilisation in total. Among these, the installed milk powder processing capacity is about 100,000 metric tons per year but plants operate at below 40% capacity due to competition with cheap milk powder dumped in the market from EU countries (offering export subsides to milk powder).

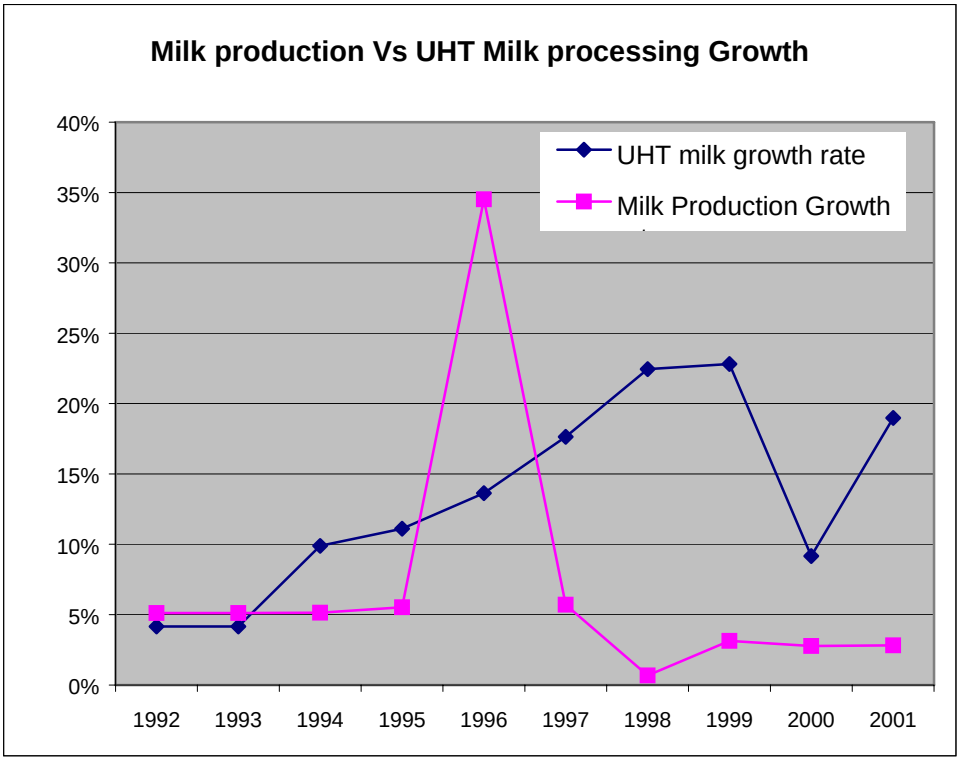


Figure 18. Growth in demand for processed milk, 1992-2001

Tariff on imported milk powder and income tax exemption to dairy farmers

This policy was pursued since the middle of the 1970s with the intention to protect domestic dairy producers and contribute to increased domestic production. During 1978 to 1987, domestic prices of milk were on average 80% higher than import parity prices. Using the equilibrium exchange rate of 1972-87, on average there was 35% import duty on milk. At present, even after structural adjustment policies, 25% custom duty is imposed on imported dairy products generally but it is 10% in case the imported milk product is used as raw material for further milk processing. Currently the landed price of imported milk powder from EU is US$1000 per ton compared to US$1920 for local product. The European Union is offering export subsidy of US$660 per ton for milk powder.

In reality, protection and income tax exemption might have slowed down growth rate and competitiveness by offering better price and income from low productivity. As mentioned earlier, current capacity utilization in the milk powder processing industry is about 40% with about 180 days of operation.

Other Policies Indirectly Affecting the Dairy Sector

Promotion of green revolution technologies

Since the mid 1960s, investment in Green Revolution technologies – high yielding varieties of cereals, chemical fertilisers, pesticides, and irrigation, and mechanisation of different farm operations at a later stage – significantly increased cereal crop productivity and output. Success in the crop sector created a platform for diversification of farm and non-farm activities in the rural areas including the livestock sector, especially the dairy sector. Some of the green revolution technologies created direct impact on the diary sector while others made indirect impact.

Increased cereal productivity and output helped to reduce prices of cereals relative to other commodities in both rural and urban areas. This along with increased income from high crop sector growth created demand for better quality foods including livestock products. Thus this created market opportunity or incentive for crop producers to diversify into higher value products such as milk, meat and also vegetables and fruits.

Irrigation expansion along with other technological changes combined with labour scarcity and higher labour cost led to adoption of mechanisation in various farm operations. This resulted in reduction of number of draft animals and their follower herds, but increased the number of dairy animals as more dairy animals could be raised with available feed. Since buffalo is preferred for milk

production due to the higher fat content of buffalo milk, buffalo population increased at a faster rate than the cattle population (Table 11).

Consequently growth in milk production increased rapidly, especially after 1980, mainly due to increased buffalo population and also due to improved milk yield as explained earlier. Punjab, where irrigation expansion was more widely spread, also experienced greater increase in buffalo population and better milk yield growth. Also irrigation and higher cereal productivity has allowed to increase green fodder production for dairy animals from 1.27 million ha in 1960s to about 2.2 million ha at present, which contributed to higher productivity.

Exchange rates

Overvalued exchange rates in the 1960s resulted in negative protection for the domestic economy, especially for the tradable items. Policy simulation from the 1960s through the 1980s indicated that free trade in milk powder would have reduced producer prices of milk by about 60% and consumer prices by about 40% in the 1980s, consequently milk output would have increased by 41% and milk consumption by 27% (Dorosh and Valdes, 1990). These were potential losses for the dairy sector and the national economy.

Tax on agricultural inputs and processed milk products

This is a recently introduced policy. Tax on inputs is mainly applicable to seeds, fertilisers, pesticides so the crop sector was directly affected. The likely impact on the dairy sector has been indirect through lower cereal crop residue output, the main source of feed, and lower fodder production for commercial dairy farms. Tax on milk and milk products e.g. pasteurised and UHT milk, butter, cheese, yoghurt, flavoured milk, is currently under discussion. Its likely effect will be to limit the market by making them costly for lower to middle income consumers. Tax on pasteurised and UHT milk may slow down the demand by making it expensive for lower income consumers.

Prohibition of animal rearing in metropolitan city areas

Like many other developing countries, urban dairy has been a common feature in Pakistan cities. The largest concentration of animals used to be in Karachi and Lahore with large populations and large milk markets. While Lahore used to receive milk supplies from a large river belt in the Punjab, Karachi being located on the sea had a much smaller hinterland. However, the health and transport hazards created by animals in Karachi became serious enough to compel the Karachi Municipal Authority to promulgate a law in 1965 to ban animals from the metropolitan areas. Instead a dairy colony was created in Landhi area, a few kilometres outside Karachi, where farmers were allocated a piece of land to establish stall-fed dairy farms. Gradually dairy animal population, mainly buffaloes, increased rapidly and the area became one of the densely populated livestock rearing area in the world. Population of Karachi still preferred raw milk so a new marketing chain involving wholesalers and retailers emerged, also a feed production and supply chain and breeding stock supply chain emerged linking distant districts in Sindh and Punjab. Thus the system has contributed to increased milk output by making a backward linkage with feed and stock suppliers in the rural areas and a forward linkage with consumers in the city.

The new system has also created some problems. Since raising pregnant and dry cows in this system became very expensive, farmers sell dry cows, even after the first lactation, to slaughter houses in Karachi and immediately buy pregnant heifers or milking animals, causing a serious drain on the country's productive animal genetic resources. The colony has no waste disposal or management policy so manure pile up layer after layer and also much of this is drained to the nearby sea causing serious environmental problems in the nearby areas. Because of the expansion of the city, the dairy colony is no longer outside the city, rather it has become a part of the city with all the potential hazards that a concentrated dairy population system can create. Several attempts to relocate it further away and to introduce environmental management procedures have gone virtually nowhere.

Lahore Municipality also promulgated a law in 1985 banning animals in the Municipal area but it did not become fully operational until 1995. Farmers were allocated land in a number of small milk colonies outside the city but due to the rapid expansion of the city most of these dairy colonies are now within the city boundary as well. This relocation has contributed to increased output as producers started using intensive production methods selecting better yielding animals and feeding them with concentrates. It has also changed the marketing pattern of milk creating a new set of milk wholesalers and retailers as in Karachi.

Quality control of milk

Concern for better food quality and safety is gaining prominence among urban consumers because of better awareness and a host of other reasons. In case of dairy, the importance of quality and safety increased with urbanization, commercial production and emergence of longer market chain from producer to consumer.

Quality of milk is controlled in the country under the Food Act of 1965, which specifies the quality of raw milk and sets standards for cow and buffalo raw milk separately. The law specifies the fat and solid not fat (SNF) contents of milk to be 3.5% and 8.9% respectively. However, this act and other subsidiary food laws are inadequate to cover all aspects of food quality demanded by modern day consumers. The food law specifies only the chemical properties of dairy products but it does not say much about the biological properties of the food items. Food regulations do not explicitly restrict the use of hazardous preservatives in milk. At present the situation is that Penicillin, Formalin, Hydrogen Per-oxide, milk productivity hormones and many other highly harmful preservatives are being used in milk. The long-term affects of these preservatives on human health may be catastrophic. In addition, adulteration by mixing water (30-60%), whose quality is not always clear, is common. The local government authorities and the Health Department are jointly responsible for enforcing the act but both are ill equipped with inappropriate technology and inadequate manpower to perform the function, and the food act is generally not enforced.

Explaining Differences in Dairy Development Between Punjab and Sindh

In the introductory section, some differences in dairy production environment between Punjab and Sindh were indicated. In order to explain the contribution of these and other factors on differences in dairy growth, it was envisaged that econometric analysis would be applied to district level secondary data, if available. However, apart from decennial population and livestock census, very few other statistics are generated and published for district level. Instead, limited data available for selected time points were used to analyse general trend in dairy growth by taking milk production per worker as an indicator for dairy sector development and relate to that a set of factors representing demography, demand, technology and input market etc. As explained in the conceptual framework, milk production per worker is expected to increase as the dairy sector develops and becomes more specialized and commercialised. The discussion in this section is based on the data presented in Table 13 and Table 14 for Punjab and Sindh respectively.

The transformation and commercialisation of the livestock sector in both the provinces was primarily driven by changes in demand and success with Green Revolution technologies in the 1970s and 1980s (high yielding cereals, irrigation, fertilisers, pesticides, tractors and other mechanical equipments) played a major in this transformation from both supply and demand sides but at different rates in Punjab and Sindh. On the demand side, higher crop productivity levels led to increases in rural household incomes, which increased the demand for milk and other dairy products. Higher crop productivity reduced real prices of cereal for urban consumers hence released income to increase demand for dairy products. On the supply side, promotion of irrigation and mechanisation of farm operations released many draft animals that made way for increased number of dairy cows to be used for milk production. In general, development in input markets, agricultural services and mechanization resulted in substantial cereal crop productivity and output gains. All the indicators for input markets presented in Table 13 and Table 14 indicate that Punjab has utilized higher level of inputs. For instance, in 1960 fertilizer application was 16 kilograms per hectare (kg/h) and 14 kg/h in Punjab and Sindh respectively, but by 1986 Punjab used 144 kg/h of fertilizer, almost double the amount in Sindh. As a result, cereal production per worker has been higher in Punjab than in Sindh, and this has indirectly (via feed availability) contributed to greater levels of milk production per capita (Figure 18) and milk production per worker (Figure 19) in Punjab. With these developments continuing beyond the mid 1980s, the rise in cereal productivity enhanced feed availability by releasing land to increase green fodder production for dairy animals, especially in Punjab.

Table 13. Indicators of milk production growth and related factors for Punjab province

	1960	1972	1986	1996	2000
Milk production (million tonnes)	4.4	5.7	8.0	15.9	18.9
Annual growth rate of milk production (percent)	-	2.2	2.5	7.1	4.4
Milk production per capita (tonnes)	0.12	0.10	0.11	0.22	0.25
Milk production per worker (tonnes)	0.81	0.92	1.10	2.09	2.32
Input markets:					
Fertilizer use (kgs/ha)	16	50	144	152	166
Number of Tractors	6157	25394	126968	210628	221159
Cereal production per worker (tonnes)	0.80	1.28	2.10	2.02	2.77
Feed:					
Purchased feed per milking animal (tonnes)	0.02	0.05	0.07	0.10	0.11
Green fodder per milking animal (hectares)	0.17	0.17	0.13	0.12	0.09
Technology:					
Milk yield per milking animal (tonnes)	0.56	0.73	0.81	1.41	1.46
Percentage of vaccinated animals (cattle +buffalo)	6	12	24	30	37
Total Cattle (million heads)	9.7	8.2	8.8	9.4	10.4
Total Buffalo (million heads)	6.1	7.4	11.2	13.1	15.5
Total Cattle and Buffalo (million heads)	15.8	15.6	20.0	22.5	25.9
Total milking animals (million heads)	7.9	7.8	10.0	11.2	13.0
Labour market:					
Percentage employed in agriculture	60	58	56	45	40
Percentage employed in manufacture, services, others	37	40	43	55	60
Infrastructure:					
Road network (km)	10635	21271	25940	30320	42307
Urbanization:					
Percent of urban population	26	27	32	33	32
Consumer demand:					
Per capita milk consumption (tonnes)	0.106	0.087	0.092	0.174	0.187
Per capita butter consumption (tonnes)	0.032	0.026	0.028	0.052	0.056
Per capita cheese consumption (tonnes)			0.005	0.009	0.009
Commercialisation of dairy sector:					
Proportion of milk production sold	10	18	21	25	27
Milk purchases of consumers (shares):					
From neighbourhood producers	0.05	0.03	0.03	0.02	0.02
From traders	0.95	0.94	0.94	0.93	0.93
From stores and supermarkets	0	0.03	0.03	0.04	0.05
Milk sales of producers (shares):					
To cooperatives and societies	0	0.02	0.02	0.02	0.02
To traders	0.95	0.92	0.92	0.91	0.90
Directly to consumers	0.05	0.05	0.05	0.05	0.05
Processing companies	0	0.01	0.01	0.02	0.03
Real milk prices in Lahore, Punjab (Rs/litre; 2000 prices)	32	57	17	13	16

Table 14. Indicators of milk production growth and related factors for Sindh province.

	1960	1972	1986	1996	2000
Milk production (million tonnes)	1.0	1.2	2.3	6.8	7.7
Annual growth rate of milk production (percent)	-	1.4	5.0	11.4	3.2
Milk production per capita (tonnes)	0.07	0.05	0.08	0.23	0.25
Milk production per worker (tonnes)	0.62	0.58	0.84	2.23	2.29
Input markets:					
Fertilizer use (kg/ha)	14	45	80	106	103
Number of Tractors	2031	5079	25394	42126	44232
Cereal production per worker (tonnes)	0.74	1.10	1.35	1.41	1.16
Feed:					
Purchased feed per milking animal (tonnes)	0.017	0.030	0.031	0.026	0.029
Green fodder per milking animal (hectares)	0.16	0.15	0.07	0.04	0.03
Technology:					
Milk yield per milking animal (tonnes)	0.47	0.54	0.53	0.82	0.85
Percentage of vaccinated animals (cattle +buffalo)	5	7	7	9	11
Total Cattle (million heads)	2.9	2.8	5.5	11.1	12.3
Total Buffalo (million heads)	1.4	1.5	3.2	5.6	5.9
Total Cattle and Buffalo (million heads)	4.3	4.3	8.7	16.7	18.2
Total milking animals (million heads)	2.1	2.2	4.3	8.3	9.1
Labour market:					
Percentage employed in agriculture	60	58	56	45	40
Percentage employed in manufacture, services and other	40	42	44	55	60
Infrastructure:					
Road network (km)	3191	6381	7782	9096	12692
Urbanization:					
Percent of urban population	41	43	44	45	45
Consumer demand:					
Per capita milk consumption (tonnes)	0.049	0.037	0.058	0.162	0.173
Per capita butter consumption (tonnes)	0.020	0.011	0.014	0.040	0.043
Commercialisation of dairy sector:					
Proportion of milk production sold	5	10	15	20	25
Milk purchases of consumers (shares):					
From neighbourhood producers	0.10	0.10	0.10	0.10	0.10
From traders	0.90	0.90	0.88	0.88	0.88
From stores and supermarkets	0	0.001	0.02	0.02	0.02
Milk sales of producers (shares):					
To cooperatives and societies	0	0	0	0	0.02
To traders	0.90	0.90	0.88	0.88	0.86
Directly to consumers	0.10	0.10	0.10	0.10	0.10
Processing companies	0	0.001	0.02	0.02	0.02
Real milk prices in Karachi city, Sindh (Rs/litre; 2000 prices)	34	47	23	25	23

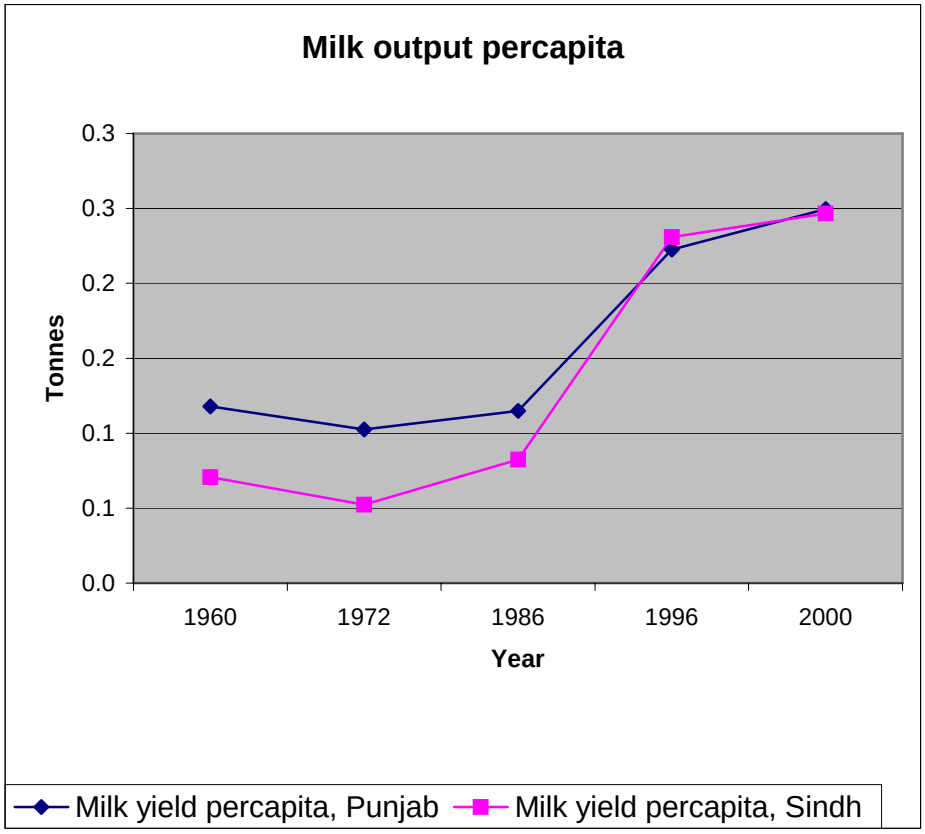


Figure 18. Milk production per capita, Punjab and Sindh, 1960-2000

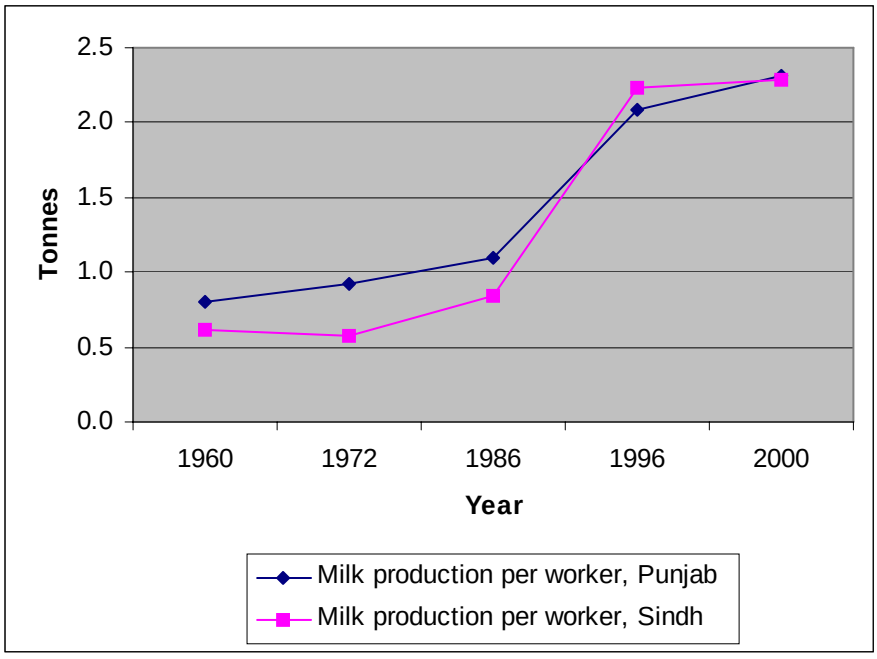


Figure 19. Milk production per worker, Punjab and Sindh, 1960-2000

High investments in farm mechanization coupled with developments in the labour market (more workers leaving the farm for off-farm employment opportunities) resulted in a substitution of draft animals for tractors, and this substitution was faster and more intensive in Punjab where green

revolution started much earlier and on a wider scale. With increased use of tractors, draft animals were replaced by milking animals leading to increased numbers of milking animals that could be raised with the available feed. Most of these increased animals were better yielding buffaloes, especially in Punjab, where share of buffalo in dairy population increased from 39% in 1960 to 60% in 2000 compared to 33 and 32% in those two years in Sindh. Purchased feed, especially cottonseed and oilseed cakes per milking animal has increased in both provinces, but it was faster in Punjab[4] (Figure 20). On the other hand, green fodder per milking animal has been declining, especially in Sindh, as green fodder production has not been able to keep up with the growth in milking animal population. These changes contributed to a faster growth in per animal yield, specially in Punjab where between 1986 and 2000 yield increased by about 80% compared to about 60% in Sindh

Another factor that has contributed to better dairy sector performance in Punjab is the use of better genetic material and health management. Compared to Sindh, Punjab has had a larger proportion of its cattle and buffalos vaccinated and inseminated artificially throughout the period under study, so milk production per milking animal in Punjab has remained at higher levels than Sindh's.

Although initially milk production per worker in Sindh was much lower than in Punjab, a considerable jump in milk production and milk production per worker occurred in the province between 1986 and 1996 allowing to catch up to levels in Punjab. Several factors contributed to this outcome. The total number of milking animals in the province doubled during 1986-2000 from 4.3 million heads to 8.3 million heads (Table 13 and Table 14). More importantly, milk production per milking animal increased sharply from 0.53 tonnes in 1986 to 0.82 tonnes in 1996. Growth of cereal production per worker increased in Sindh during 1986 and 1996, while Punjab experienced a drop in cereal production per worker in this period, and this may have also had a part to play, as cereal crop residue output is the main source of feed. Also the percentage of people employed in agriculture declined from 56 percent to 45 percent due to developments in the labour market. In addition, a dramatic change occurred in Sindh's per capita milk consumption, which grew from 0.06 tonnes in 1986 to 0.16 tonnes in 1996 almost closing the per capita milk consumption gap between Punjab and Sindh (Figure 21). Although Sindh province is more urbanized, per capita milk consumption is higher in Punjab, probably due to differences in consumer preferences and other factors not evaluated here.

The degree of commercialisation of Punjab's and Sindh's dairy sectors can be seen by observing the proportion of milk production that is sold (Table 13 and Table 14). In both the provinces, the dairy sector steadily commercialised but Sindh, where the degree of commercialization was much lower than in Punjab between 1960 and the mid 1980s, has managed to catch up to Punjab's levels especially after the mid 1990s. Two separate marketing institutions have developed in the two provinces, which also played a minor role with about 2% of the market share yet might have contributed to differential dairy growth. In Punjab, cooperatives initially developed by the public sector and later taken over by a self-managed entity, and another set of farmer groups promoted by a private sector dairy processing industry, both enhanced dairy growth by providing improved inputs and services and regular market outlets for products. In Sindh, the highly concentrated intensive peri-urban dairy production system

[4] In this analysis, cottonseed and rapeseed cakes represent purchased feed. Although fodder and purchased feed might have been used for non-dairy animals such as followers, the usual practice is to give preference to milking cows for better quality feeds, hence the aggregate feed quantities are expressed on a per milk cow basis.

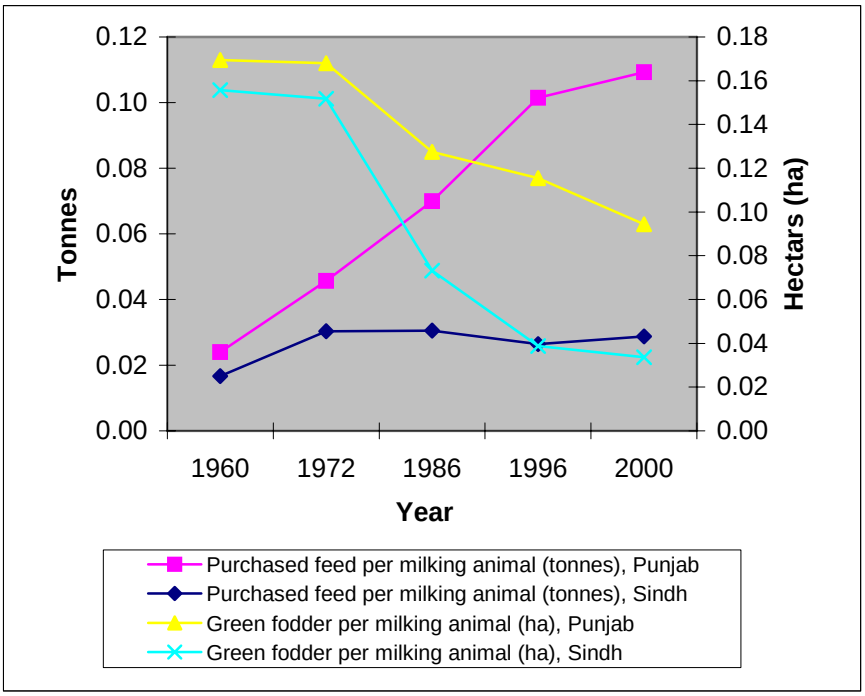


Figure 20. Sources and intensity of feed use for animals, 1960-2000

Note: In this analysis, cottonseed and rapeseed cakes represent purchased feed.

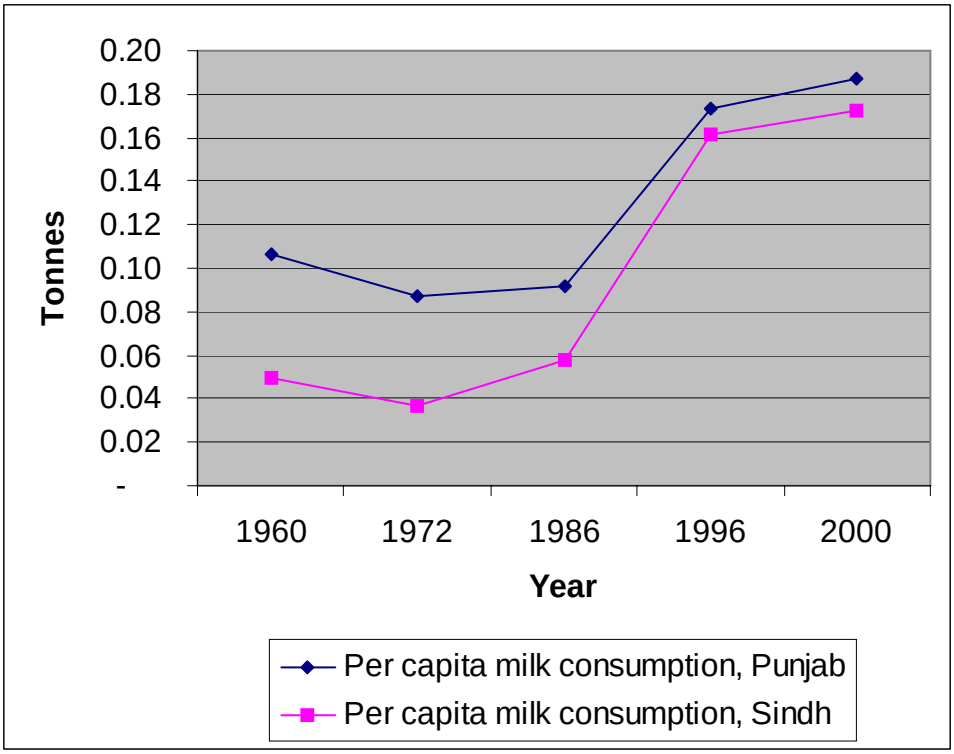


Figure 21. Per capita milk consumption, Punjab and Sindh,

emerged by creating a backward linkage to rural areas for feed and a forward linkage through informal milk marketing to urban consumers. This system supply about 70% of Karachi's milk consumption. As a result of the changes and developments in the demand and supply of dairy

products, real milk prices have generally declined over the time period under study benefiting the consumers (Figure 22)

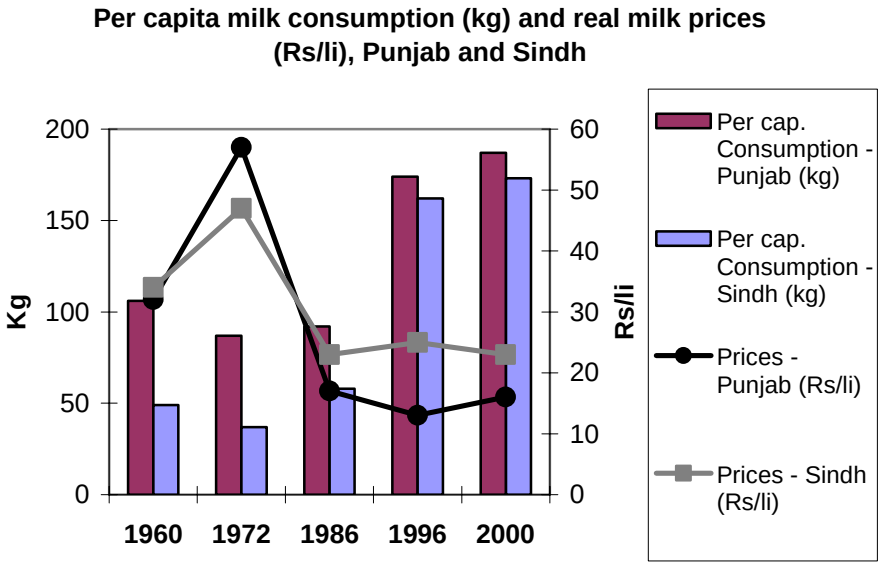


Figure 22. Real prices and per capita consumption of milk, Punjab and Sindh provinces, 1960-2000.

Another aspect of the commercialisation and development of the livestock sector has been the changes in the structure of purchases and sales in the milk markets. Informal traders and market agents handle about 90% and 85% of milk in Punjab and Sindh respectively. These shares have remained relatively stable in spite of four to seven times increase in milk production because demand for processed milk, for that matter expansion of the formal sector involvement in marketing, remained fairly small. However, some structural changes have occurred with urbanization as indicated by sources of purchases by consumers and sales outlets of producers. Share of total milk purchases by consumers from neighbourhood producers (i.e. producer to consumer sales) has marginally decreased while share of milk purchases from traders as well as stores and supermarkets has increased (Table 13, 14). The same trend is confirmed by looking at sales outlets of producers . Share of direct milk sales to consumers has decreased to some extent and share of sales to processing companies, cooperatives and societies has increased and sales to informal traders remain the largest outlet (Table 13, 14).

A total of 3.3 million litres of milk is consumed daily in Lahore, out of which 8% is handled by the formal processing sector, 20 percent is handled by large distributors while the majority, that is 72 percent is handled by small-scale milkmen in the informal sector. Therefore, the informal sector plays a critical role in Lahore's milk market.

Karachi has around 10.5 million inhabitants with daily milk consumption of 4 to5 million litres, thus making it the biggest milk consumption market in Sindh region and in all of Pakistan. Peri-urban areas and cattle colonies supply 70% of Karachi's milk supply and 30% comes from rural areas. Although peri-urban farmers sell their milk to both formal and informal channels, most of the milk is sold to traders in the informal sector under prior-agreements that are valid for one year. Milk traders collect milk from farmers twice a day and deliver it to urban retail shops and also directly to consumers. Thus, an efficient and vibrant informal sector dominates Karachi's milk market chain supplying fresh milk to urban consumers twice a day. Retail milk shops that are specialized in milk and milk products sell more than 50 percent of the milk in Karachi. Milk is usually stored in deep freezers or chillers for longer storage, and on average, one milk shop sells about 500 litres of milk daily. Unlike Lahore, Karachi has a very small (under 1 percent) share of processed milk market due to higher raw milk prices that are almost double the milk prices in Punjab. Farm gate milk price in peri-urban Karachi is 22 Rupees per litre. Karachi also has a unique wholesale milk market that is well organized by the private sector. The Karachi dairy association controls the milk trade on a daily basis and announces milk prices twice a day after assessing trends in the demand and supply of milk. Brokers or commission agents in the wholesale milk market charge milk buyers and sellers a commission of 25 Rupees per 40 litres of milk.

Income and Employment Opportunities in Milk Production and Marketing

Income and employment opportunities in milk production

Data from a survey conducted during 2002-03 were used for this analysis. The survey for Punjab region was conducted in rural and peri-urban areas of Lahore while the survey for Sindh was conducted in peri-urban areas of Karachi. Analysis was done for small, medium and large farms defined respectively as owning 1-2, 3-5 and more than 5 cows. However, peri-urban large dairy farms in Lahore own an average of 10 animals while in Karachi, owners of about 10 animals are called large1 and those owning an average of 20 animals are called large2 in this study.

In Punjab, small-scale milk producers own up to one acre of land or are rural landless farm households and the main source of income is off-farm employment, mostly as seasonal workers in larger crop farms in the region. Most of the milk is consumed at home as raw milk, and is used to produce milk products like butter, butter oil (ghee), milk drinks, yoghurt, etc. Only surplus milk is sold to the local milkmen for supplementing household income. On the other hand, medium scale milk producers sell about 80 percent of the milk output in local markets. Besides dairy farming, off-farm employment and cash crop production are also main sources of income. Large farms in peri-urban areas have the advantages of proximity to the market which allows milk to be sold directly to consumers via home delivery, as well as to milk shops.

In Punjab employment per 1000 litres of milk produced decline as the scale of farm increases (Table 15). Large-scale milk producers in peri-urban areas use higher levels of labour input than large-scale rural producers. Small and medium-scale producers employ 242 and 73 family workers respectively, per 1000 litres of milk handled daily. No hired workers are employed by these farm types. Large-scale rural producers employ 8.9 hired workers and 17.8 family workers while large-scale peri-urban producers employ 52.7 hired and 26.4 family workers per 1000 litres of milk handled daily.

Small and medium-scale producers obtain 33 percent of their total income from dairy activities, while large-scale rural and peri-urban producers obtain 30 and 100 percent of their income from dairy activities respectively. Income earned from dairy activities increases with the scale of milk production. There seems to be no significant association between levels of gross profit and the scale of production. Small-scale producers incurred a loss, medium-scale producers earned more than large-scale rural producers, while highest gross profit levels were attained by large-scale peri-urban producers.

Similar to the results in Punjab, employment per 1000 litres of milk in Sindh declines with the scale of farm (Table 15). On average, both groups of producers employed 86.4 workers per 1000 litres of milk produced daily (52.4 hired and 33.9 family workers). Milk producers in both groups obtain almost all of their income from dairy activities. Although income and gross profit levels are higher for the Large 1 group, gross profit per litre of milk as well as per labour hour is higher for L Large 2 group.

Table 15. Employment and income from milk production in Punjab and Karachi

Punjab			Small-Scale farms (1-2 cows)	Medium-Scale farms (3-5 cows)	Large-Scale farms (>5cows)		All Large-Scale farms (>5cows)
					Rural	Peri-urban	
	Total milk produced on a daily basis (tons/everyday)		20,926	18,173			15,970
	Rate of employment (fulltime jobs / 1000L of milk produced on a daily basis)	Self employment	242.1	73.0	17.8	26.4	22.1
		Hired personnel	0	0	8.9	52.7	30.8
		Both self and hired personnel	242.1	73.0	26.8	79.1	52.9
	Projected total employment generated in Punjab	Self employment	5,066,191	1,326,600			352,937
		Hired personnel	0	0			491,876
		Both self and hired personnel	5,066,191	1,326,600			844,813
	Gross profit from dairy (Rupees/year)		-1,953	16,075	8,592	184,225	96,409
Karachi					Urban Large 1	Urban Large 2	Large-Scale farms (>5cows)
	Total milk produced on a daily basis (tons/everyday)		6,740	7,414			8,312
	Rate of employment generation (fulltime jobs / 1000L of milk produced on a daily basis)	Self employment			33.3	34.6	33.9
		Hired personnel			55.5	49.4	52.4
		Both self and hired personnel			88.8	84.0	86.4
	Projected total employment generated in Punjab	Self employment					282,084
		Hired personnel					435,934
		Both self and hired personnel					718,018
	Gross profit from dairy (Rupees/year)				86,825	99,939	93,382

Source: Field survey

There are a total of 9.3 million farmers in Punjab region that produced 20.1 million tons of milk in 2002. About 3.9 million farmers (42 percent) are small-scale producing 38 percent of the milk. Medium and large-scale milk producers in Punjab make up 37 percent and 21 percent of the farmers, and produced 33 percent and 29 percent of the milk respectively (Figure 23). In Sindh, 3.9 million farmers produced 8.2 million tons of milk. Rural based small-scale producers account for 40 percent of Sindh's milk producers producing 30 percent of the region's milk. Medium scale producers represent 33 percent of the farmers and produced 33 percent of the milk whereas large-scale farmers (in both rural and peri-urban areas) make up 27 percent of the milk producers and produced 37 percent of milk. The ratio of milk production by large-scale farmers is higher in Sindh compared to Punjab due to commercial peri-urban farming in the former, especially in Karachi and Hyderabad districts. In Sindh, 41% of produced milk was sold in 2002 compared to 26% in Punjab as producers in Punjab are more rural and they also process a larger amount of milk into ghee and yoghurt for both home consumption and sale.

Extrapolation of farm survey results to the province level indicate that the number of workers employed in milk production total 8.6 million in Punjab and 3.2 million in Sindh (Figure 24). The structure of employment is similar in both provinces, with most workers employed in small-scale milk production, fewer workers employed in medium-scale milk production, and large-scale production employing the least number of workers.

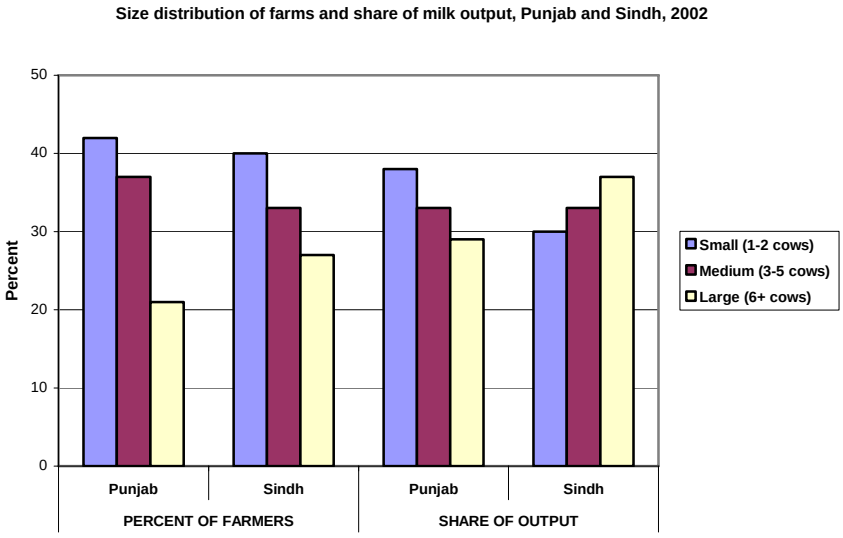


Figure 23. Share of the total number of farmers and milk production by farm size in Punjab and Sindh, 2002

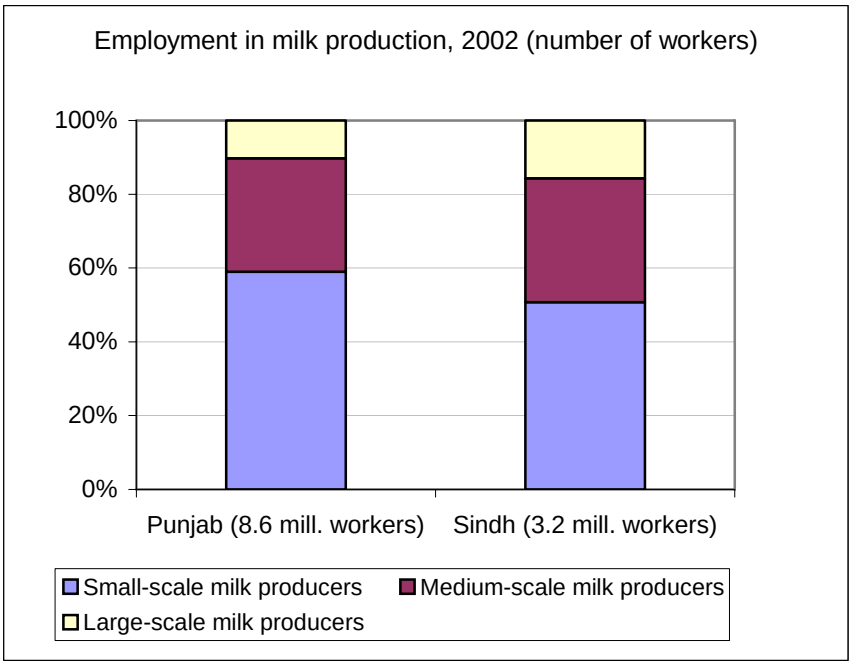


Figure 24. Share of employment generation in milk production by farm size in Punjab and Sindh, 2002

Income and employment opportunities in milk markets

Data from a milk market survey conducted during 2003-04 in Lahore and Karachi were used for this analysis. The formal sector is comprised of modern milk processors producing ultra heat treated (UHT) milk, pasteurised milk, and other high value processed dairy products, while the informal sector is mainly comprised of milkmen dealing with raw milk and other traditional dairy products. The informal sector also includes milk collection agents and milk shops. Distributors (also part of the informal sector) are those specialized in delivering pasteurised and UHT milk (and are hereafter simply referred to as distributors). Unlike the farm level analysis, there is no distinction between small, medium and large scales of operation. Hence, formal processors and the informal sector represent marketing agents of various scales.

Data were collected on both direct and indirect job opportunities arising out of formal milk processing and informal milk marketing activities. Direct employment in the formal sector included all workers (both permanent and casual) employed directly by the dairy processors while indirect employment entailed jobs generated in other firms that provide services and inputs to the dairy processors. In the informal sector, direct employment included self, family and wage employment while indirect employment referred to persons involved in providing services to the informal milk market agents.

In Lahore the sampled distributors have utilized 93 percent of their working capacity, the rest of the informal sector and formal processors have on average utilized 88 percent and 52 percent of their working capacity (Table 16). Formal processors handle the highest quantity of milk per worker while the informal sector handles the least volume of milk per worker. However, the informal sector (the majority of which are small-scale milkmen) generates the highest amount of employment per unit of milk (9 jobs per 1000 litres of milk), compared to distributors and formal processors that generate 4 jobs and 3 jobs per 1000 litres of milk respectively. Formal processors provide 336 direct jobs while the informal sector and distributors provide 3 and 2 direct jobs respectively. Women constituted under 1% of employment by formal processors and information on the proportion of women employees was not available for distributors and the informal sector. Formal processors generate 36 indirect jobs (gender division was not available) while distributors and the rest of the informal sector generate no indirect jobs. Average salary per worker was the highest for formal processors, compared to salaries earned by distributors and traders engaged in the informal sector.

In Karachi, the informal (including small-scale milkmen and distributors) and formal sectors handle 93 percent and 7 percent of the total milk consumed in the city, respectively. Formal processors utilize only 23 percent of their working capacity. In contrast to Lahore, formal processors in Karachi generate the highest number of jobs per unit of milk (4 jobs per 1000 litres of milk) compared to the informal sector and distributors that generate 3 jobs and 1 job per 1000 litres of milk respectively. One reason for fewer numbers of jobs per unit of milk handled in the informal sector is that milk production is mostly concentrated in the urban/peri-urban area in densely populated milk colonies so traders require less time to assemble and transport milk to the market, and additionally

they gain from economy of larger volume. Information on the gender aspects of employment generation in Karachi was not available, but is likely to occur mostly among males. Distributors earn the highest average monthly salary or wage per worker, whereas formal processors and traders in the informal sector, on average, earn similar monthly income.

Extending the survey results to the province level, in Punjab, milk trading in the informal sector generates 158,600 jobs while milk-processing companies generate 3,100 jobs. Similarly, the informal sector in Sindh is more important in employment generation creating 32,600 job opportunities whereas processing companies only generate 4,200 jobs.

Table 16. Income and employment in milk marketing and processing in Lahore, Punjab, and Karachi, Sindh

			Formal processors	Distributors	Informal sector	Total
Lahore, Punjab	Average litres of milk handled (litres per agent day)		266,900	608	873	268,381
			Formal processors	Distributors	Informal sector	Weighted mean
	Rate of employment (fulltime jobs / 1000L of milk handled on a daily basis)	Direct employment	1.26	3.29	3.44	1.3
		Indirect employment	0.13	0.00	0.00	0.1
		Total employment	1.39	3.29	3.44	1.4
	Projected total employment generated in Punjab		Formal processors	Distributors	Informal sector	Total
		Direct employment	2,841	7,419	158,558	168,818
		Indirect employment	293	0	0	293
		Total employment	3,135	7,419	158,558	169,111
	Average monthly salary (Rupees per worker and $)		Formal processors	Distributors	Informal sector	Weighted mean
			3,575 ($61)	2,750 ($47)	2,238 ($38)	2285 ($39)
			Formal processors	Distributors	Informal sector	Total
Sindh, Karachi	Average litres of milk handled (litres per agent day)		43,300	5,000	2,900	51,200
	Rate of employment (fulltime jobs / 1000L of milk handled on a daily basis)		Formal processors	Distributors	Informal sector	Weighted mean
		Direct employment	2.9	0.6	2.4	2.6
		Indirect employment	1.2	0.0	0.0	1.0
		Total employment	4.0	0.6	2.4	3.6
	Projected total employment generated in Sindh		Formal processors	Distributors	Informal sector	Total
		Direct employment	2,964	613	32,593	36,171
		Indirect employment	1,227	0	0	1,227
		Total employment	4,191	613	32,593	37,398
	Average monthly salary (Rupees per worker)		Formal processors	Distributors	Informal sector	Weighted mean
			2,800 ($47)	3,500 ($59)	2,380 ($40)	2445 ($42)

Source:[5] Milk market surveys by APSI experts, 2003-2004

[5] Employment projections are based on relative market shares (formal 7%, informal 93%). It is further assumed that all processed milk passes through the distributors, and that 35% of milk produced is retained on farm for calves and home consumption as raw, the remainder is processed into ghee, yoghurt etc. .

Main Lessons from Pakistan's Dairy Development

Identification of effects of key factors and policies on dairy development trends

From a historical perspective, two broad sets of policy measures influenced dairy sector growth directly and/or indirectly: (a) policies, institutions and programmes for improving dairy production and marketing ,and (b) other policies that indirectly impacted the dairy sector.

Several policy, institution and programme areas stand out as major contributors to dairy development through improvement in production and marketing. First, increased public investment in extension, research and other support services, especially investment in artificial insemination and other breeding services and veterinary services, contributed significantly to yield and output growth by improving the genetic, health and overall quality of dairy animals.

Second, targeted dairy development projects in specific parts of the country for promotion of improved feed, management and genetics as well as dairy cooperatives to improve market access for inputs, services and products contributed to dairy growth. A public sector supported dairy cooperative project, namely Idare-e-Kishan, which later became more autonomous in terms of management, and a Nestle (a private dairy processing industry) led farmers' group organization for delivery of improved technology and for marketing of milk, both developed in Punjab, played key roles in dairy development in that province.

Third, the policy of public sector investment in milk processing and marketing infrastructure was pursued in the 1970s to promote formal sector milk market on the assumption that there was demand for processed milk, and linking that demand backward to producers would contribute to rapid dairy growth. However, the investment in formal milk processing industry did not succeed in expanding formal milk marketing as consumers were not yet ready to pay for such value addition and tastes did not change as rapidly as anticipated. Later these enterprises have been privatised and incentives were given though cheap credit and tax relief on imported machineries to establish processing plants. However, such incentives led to overinvestment and over capacity as demand for formally processed dairy products has been increasing rather slowly.

Among the policies that indirectly impacted on the dairy sector, the promotion of green revolution technologies stand out clearly as it contributed to dairy growth from both supply and demand sides. On the demand side, higher cereal productivity and rural income enhanced demand for livestock products in the rural areas, and higher cereal productivity reduced real prices of cereals for urban consumers, so enhanced their ability to increase consumption of dairy products. Thus green revolution induced demand growth acted as a pull factor for dairy development. On the supply side, three interrelated factors emerged that contributed to enhance dairy growth. Mechanization of various farm operations at mature stages of green revolution released draft animals thereby created room for increased number of dairy cows to be raised with available feed. Cattle were more used for draft purposes, so mechanisation allowed an increase in the buffalo population, and a higher milk yielding animal. Higher cereal productivity also released some land to increase production of green fodder for dairy animals. These factors together resulted in higher yield per animal and in higher output.

Second, overvalued exchange rate policies pursued in the 1960s protected the domestic market but stifled growth by giving a reasonable income from low productivity and providing disincentive to invest in productivity improving technologies. Combined with this, the policy on high import duty on imported dairy products, mainly powdered milk, also stifled growth as it discouraged domestic producers to be competitive.

Third, an important regulation that banned rearing dairy animals in urban centres, changed the location of production and system of marketing. Following the ban, dairy colonies have been built in per-urban areas where intensive dairy farming practices have developed based on purchased feed, both concentrates and green feed from rural areas. Also a vibrant informal milk marketing system has emerged to serve urban consumers. The other regulation is related to food hygiene and quality control. The existing food laws are ill defined to meet the need of quality assurance for modern day consumers and it is even more ineffective because of lack of enforcement of existing rules and procedures. Although informal milk market plays a vital role in the industry, in the absence of proper regulations and enforcement and also in the absence of appropriate technology, this market channel does not satisfy most of the quality and hygiene concerns of consumers.

Milk production in the country is concentrated in Punjab and Sindh and growth patterns and trends in the two provinces were different. In both the provinces milk production increased slowly until 1986 and thereafter increased very rapidly. Initially milk production per capita and per agricultural worker was much higher in Punjab but by the mid 1990s, Sindh caught up with Punjab. These differences could be explained by a number of factors. First, the time path for dissemination of green revolution technologies, which contributed to dairy growth from both supply and demand sides, was different. It occurred earlier, faster and more widely in Punjab than in Sindh. Second, investment and promotion of improved dairy technology in terms of genetics, health and feeds were more intensive in Punjab than in Sindh. Third, public and private sector investment in building cooperatives and farmer groups for provision of inputs and services and regular market outlets were much more focused on Punjab than in Sindh.

Identification of effects of trends, key factors and policies on the poor

Overall, given the developments that have taken place in the livestock sectors of Punjab and Sindh, it can be said that Pakistan's diary sector has evolved from a complementary enterprise in smallholder mixed farming system to one that has become more specialized and commercialised, and is still in the process of further specialization and development. The effect of this dynamic process, and the policies and institutions that made the process possible, on the poor may be guessed by looking at structural change in the production and marketing systems, the impact on employment and income, and also opportunities that might have been lost due to certain policy measures.

With respect to change in the production structure, specialization and concentration has occurred primarily in the dairy colonies in peri-urban areas and in the peri-urban supply hinterland of the cities where intensive dairy farming is being practiced and average herd size has been increasing to some extent and is currently several times larger than in the remote rural areas. These farms captured a large proportion of the expanding urban market which is largely served by the informal marketing channels involving mostly small and medium scale traders. In the rural areas, the livelihood of the majority of milk producers and marketing agents in Punjab and Sindh is based on small-scale milk production and milk marketing in the informal sector. Rural dairy production remains primarily a component of mixed farming systems in the country but the degree of commercialization has increased because average dairy herd size has been increasing slowly apparently due to mechanization and replacement of draft animals with milk animals, adoption of more productive animals, and increasingly larger number of farmers selling a larger proportion of their milk in the market. This phenomenon is observed more where cooperatives and farmer groups have created opportunities for access to improved inputs and technology as well as output market. Dairy growth resulted in lower real prices which might have enabled more poorer people to increase consumption.

With respect to income and employment effect, large-scale farmers as well as milk processors and distributors engaged in the urban/peri-urban production and marketing systems earn higher incomes than small and medium-scale producers and milk traders in the informal sector in the rural areas. However, small-scale rural production and informal marketing created more jobs per unit of milk produced and marketed, so these producers and market agents created a much larger aggregate impact on the economy because of the involvement of a large number of people distributed over large geographical areas.

Policies that provided protection to domestic producers e.g. the overvalued exchange rate and import tax on imports of dairy, and policies that promoted formal marketing and processing which did not materialize due to lack of demand, in effect resulted in lost opportunities for small-holder dairy producers. If the same public investment was made for building institutions and infrastructure to support smallholder dairy producers and informal market agents to help improve production and marketing over an extended period, the cumulative results could be more beneficial for both rural producers and market agents and for urban consumers.

Identification of policy opportunities and entry points

The findings narrated above point to a number of policy opportunities to facilitate dairy sector development, especially to use smallholder dairy as a tool for poverty alleviation, and income and employment generation.

First, where livestock is a component of mixed farming system as in Pakistan, there seems to be a clear sequence of crop and livestock development. There is clear evidence that significant development in the crop sector in terms of production, productivity, input and output marketing and market infrastructure should precede dairy and livestock development. This seems logical because both poor mixed farmers and urban consumers try to achieve energy security before they improve the quality of their diet with increased income. Once the crop sector development generates income and marketable food surplus, attention can be given to deploy farm resources for improving productivity of livestock. The road and other market infrastructure e.g. input marketing systems, created for crop sector development may complement dairy and other livestock development efforts though new infrastructure and institutions specifically targeted to dairy and livestock have to be created. Public policies and strategies that recognize this sequence and create integrated but balanced programmes and institutions to promote crop, livestock and other sub-sector development are likely to be more efficient and more successful.

Second, it is not necessary to establish large dairy farms either in rural or peri-urban areas to promote commercialisation of dairy. High income and employment potential of small-scale diary means that if necessary technologies are provided and market institutions are promoted for small-scale milk producers and market agents, overall employment and income generation can be increased, which will enhance the welfare of the majority of the population engaged in milk production and marketing. This may create a momentum for change in dairy production and marketing structure in the country propelled by general structural changes in the agricultural sector and the economy when most production units may gradually become larger.

Third, in spite of substantial increase in dairy production, demand for processed dairy products still remains low, so informal market still supplies majority of the consumer demand. This is changing slowly but steadily with rapid urbanization and income growth and also due to changes in the marketing chain, e.g. emergence of supermarkets. However, consumers in general are showing more concern about food quality, safety, convenience and hygiene in both formal and informal markets. Therefore, two sets of complementary policy interventions may be helpful for both producers, especially small-scale ones, and consumers. (a) Promote cooperatives and farmer groups for collection, bulking and marketing milk, irrespective of whether targeted to processing industry or for

informal raw milk market. This has the potential to minimize risk, assure quality and reduce cost of marketing and pay incentive and stable price to producers. Such a policy may harmonise the complementary roles of formal and informal milk marketing and thus promote a more balanced and equitable dairy development pathway. (b) Given general public concern about adulteration and quality of milk, and lack of properly defined regulations and enforcements to combat this problem, introduce licensing to informal traders and provide them with simple technologies to extend shelf life of raw milk. This will dissuade traders to use harmful additives, and will encourage consumers to pay price premium for assured quality within the limitations of informal marketing arrangements.

Fourth, generally urban/peri-urban dairy develop to meet urban consumer demand where poor road and other market infrastructure is a constraint for collection and delivery of milk from distant rural areas. On the other hand, transportation of feeds from rural to urban/peri-urban areas may be less difficult but manure is not normally returned to the rural areas so a net nutrient transfer to urban areas deprive farmers from using manure for soil management and create environmental management problems in urban areas. Over time, with expansion of road and communications network and with urban expansion and higher prices of land, urban/peri-urban dairy become less competitive. Moreover, urban public health and environmental regulations make operation of urban/peri-urban dairy more difficult and expensive, so dairy is relocated to rural areas. The emergence of dairy colonies in Lahore and Karachi can be explained by the same reasons. However, public policy should discourage concentration and scaling up of peri-urban dairy and encourage rural dairy for more equitable development.

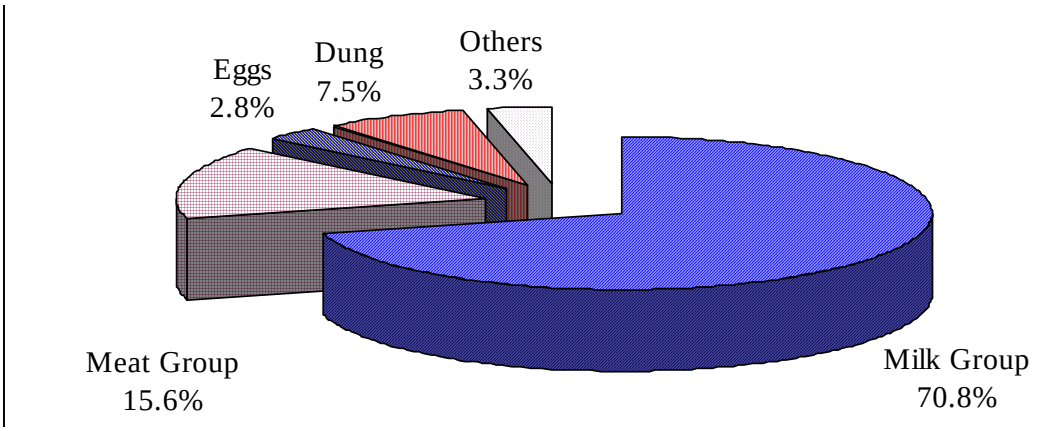
Dairy Development in India

Vijay Paul Sharma, Alejandro Nin Pratt, Anjan Kumar, RajVir Singh and Steven Staal

Introduction

The livestock sector plays an important role in the national economy and also in the socio-economic development of millions of rural households in India. It has a strategic role in ensuring food and nutrition security, income and employment generation and in balancing rural inequity. The livestock sector has been among the few growth sectors in rural India and its contribution to GDP has increased from about 4.8 per cent in 1980-81 to about 5.6 per cent in 2003-04. Though the share of agriculture in GDP has been consistently declining, the share of livestock in agricultural GDP has been increasing. That share has increased from 14 per cent in 1980-81 to over 25 percent in 2003-04. (National Accounts Statistics, 2005).

Among various livestock products, milk and milk products constitute a major share in the value of output from livestock sector. This reflects the fact that in volume terms, India is now the world's largest milk producer. Dairy's share of the total value from the livestock sector increased from about 49 per cent in 1951-52 to some 70.8 per cent in 2000-01, (equivalent to over 23 billion US$) followed by meat and meat products (15.6%), dung (7.5%), and eggs (**Error! Reference source not found.**). In fact milk and milk products have emerged as the largest agricultural commodity category in value in recent years.



Source: National Accounts Statistics, 2002

Figure 16. Share of different livestock products in total value output from livestock products, 2000-01

Dairy Development Policy

Agriculture, including the dairy sector, is a state subject, and state governments are primarily responsible for development of the sector. The Central government supplements the efforts of the state governments through various schemes for achieving accelerated growth of the sector. Though it is difficult to earmark the exact year for different phases as a shift in policy action is often staggered over a number of years, we can divide the government policies into three phases:

- Pre-Operation Flood (Pre-Independence through 1960s)
- Operation Flood and Pre-reform Period (1970s-80s)
- Post Operation Flood and Post-reform Period (1990s onwards)

A brief summary of major policy initiatives during the past few decades is given in Table 17.

Table 17. Summary of the Indian dairy sector policy and market environment

Period	Policy initiatives
Pre-Independence	• Establishment of military dairy farms to supply the colonial army in early 1910s • In 1928, the Royal Commission on Agriculture recommendation for

	breed improvement and some efforts towards breed improvement through artificial insemination • Promotion of large farms in the big cities • A cattle colony established to supply to the Government Milk Scheme in Bombay. Similar attempts at establishing cattle colonies in Calcutta and Madras • Some private sector formal milk processing plants in major cities like Mumbai, Calcutta, Madras and New Delhi
Post-Independence Pre-Operation Flood (1950s-1960s)	• In the First Five Year Plan, Key Village Scheme (KVS) implemented to improve breeding, feed and fodder availability, disease control and increase milk production. • Promotion of government owned dairy plants and Delhi Milk Scheme (DMS) started in 1959 • Milk collection through own milk collection centres as well as through small milk vendors • No major interventions for disease control except investments in veterinary hospitals and dispensaries • Second Five-Year Plan maintained and continued the same policies and strategies with no major changes • Review of the KVS recommended adoption of cross breeding on selective basis to rapidly increase the milk production • Third 5Y plan, included emphasis on dual-purpose animals for milk as well as draft purpose • Implementation of Intensive Cattle Development Programme in high potential areas • Third Five-Year Plan (1961-66) 55 milk supply schemes for cities and industrial townships, eight rural creameries, six milk product factories established • National Dairy Development Board, (NDDB) was set up in mid-sixties
Operation Flood and Pre-Reforms (1970s and 1980s)	• In a major policy shift, dairy development through producers' cooperatives and milk production based on milk sheds in the rural areas became the emphasis • Operation Flood Programme (OFP) launched with the help of World Food Programme (WFP), dairy commodity assistance from European Economic Community (EEC) and soft loan/credit from the World Bank • Emphasis on provision of inputs like animal health care, vaccination, improved feed and fodder, breed improvement through artificial insemination • National and Regional Milk Grids through linking surplus milk producing areas with deficit areas and urban consuming centres • Establishment of Mother Dairies in Mumbai, Calcutta, Madras and Delhi and Government Milk Schemes co-existed • Decline of City Milk Schemes and milk colonies • In 1989 Government of India launched a Technology Mission on Dairy Development (TMDD) • Integrated Dairy Development Programme (IDDP) for promoting dairy farming focusing mainly in non-OFP, hilly and backward areas. • Protection to domestic industry from dairy imports through quantitative restrictions (QRs) on imports and exports, canalization, etc. and protection to cooperative sector by prohibiting new private sector players into milk processing through licensing under Industrial Development and Regulation Act of 1951
Post-Operation Flood and Post-Reforms (1990s …..)	• In 1991, dairy industry was de-licensed to encourage private investment and flow of capital and new technology • In 1992, government promulgated the MMPO (Milk and Milk Products Order) under the Essential Commodities Act of 1955 and brought back the licensing requirements, including protection of cooperative sector • In 1995, India became member of WTO and made commitments to remove restrictions on trade in dairy sector • Non-tariff barriers on imports of Skim Milk Powder (SMP) and butter oil removed in mid-90s and on remaining products in subsequent years • In 2002, the MMPO was amended and cooperative protections were removed but regulation on standards of quality and food safety retained

	• Tenth 5Y Plan, major thrust on genetic upgrading of cattle and buffaloes, provision of health cover including creation of disease free zones, provision of nutritious feed and fodder and production of quality milk and dairy products • National project on cattle and buffalo breeding launched in 2000 • National Dairy Development Board (NDDB) evolved a Perspective Plan 2010 to strengthen cooperative dairy sector

Pre-Operation Flood (Pre-independence through 1960s)

Outside of purely traditional systems, the earliest attempts at dairy development in India can be traced back to British rule, when the Defence Department established military dairy farms to ensure supply of milk and butter to the colonial army. This approach did not have any impact on the supply of milk to urban consumers, which was of major concern to civilian authorities but less important to the military. With the growth of population in urban areas, consumers had to depend on milk vendors who kept cattle in these areas and sold their milk, often door-to-door.

To some extent, the Second World War gave impetus to private dairies with modestly modernized processing facilities. In the cities of Bombay, Calcutta, Madras and Delhi, and even in some large townships, processed milk, table butter and ice-cream were available, though not on a large scale. These dairies were not concerned with improving breeds of milch animals reared in rural areas but were content with contracting milk supplies through middlemen or their own staff. These early modern systems did not bring about any significant shifts in milk production, nor did they develop quality milch animals. Despite some modernized processing facilities, milk and dairy product marketing remained informal.

In the post-independence era, with the initiation of India's first Five-Year Plan in 1951, modernization of the dairy industry became a priority for the government. The goal was to provide hygienic milk to the country's growing urban population. Initial government action in this regard consisted of promoting state-owned dairy plants to handle milk procurement, processing, and marketing. In 1959, the government Delhi Milk Scheme (DMS) was set up to supply milk to the urban population of Delhi. Though the collection was started from small milk vendors initially, it ultimately ended up creating big contractors who purchased milk from the small vendors and supplied it in bulk to the milk scheme. In the First Five Year Plan, the Key Village Scheme (KVS), Integrated Cattle Development Project (ICDP) and some other programmes were launched to improve breeding, feed and fodder availability, disease control, and milk production. The same policies and strategies continued in the Second Five-Year Plan. The Third Plan emphasized the need to develop dual-purpose animals for milk as well as draft use; crossbreeding of indigenous cattle was introduced during this plan. .

During the 1960s, various state governments tried different strategies to develop dairying, including establishing dairies run by their own departments, setting up cattle colonies in urban areas and organizing milk schemes. Almost invariably, dairy processing plants were built in cities rather than in the milk sheds where milk was produced. Such urban orientation to milk production led to the establishment of cattle colonies in Bombay, Calcutta and Madras. These government projects had extreme difficulties in organizing rural milk procurement and running milk schemes economically, yet none concentrated on creating an organized system for procurement of milk, which was left to contractors and middlemen. Inadequate milk collection required government-run dairy plants to use large quantities of relatively cheap, commercially imported milk powder. The informal or unorganized sector consisting of milk vendors and contractors remained the dominant player. During the two decades between 1951 and 1970, the growth rate in milk production was barely 1 percent per annum (Table 18), while per capita milk availability was stagnant and sometimes declined (Figure 17).

Table 18. *Annual growth rate (%) of production of major livestock products in India*

Period	Milk	Eggs	Wool
1950-51 to 1960-61	1.64	4.63	0.38
1960-61 to 1973-74	1.15	7.91	0.34
1973-74 to 1980-81	4.51	3.79	0.77
1980-81 to 1990-91	5.68	7.80	2.32
1990-91 to 2004-05	3.95	4.46	2.01

Source: GOI (2004-05)

Operation Flood and Pre-Reforms Period (1970s – 1980s)

The disappointing performance of the dairy sector during the 1950s and 1960s concerned policy makers, and the Government of India undertook new policy initiatives in this sector. Dairy development through producers' cooperatives and milk production based on milk sheds in the rural areas, modelled on the successful experience of dairy cooperatives in Gujarat, became the

cornerstone of the new dairy development policy. This policy initiative helped to turn the Indian dairy sector around and also led to several unarticulated spread effects.

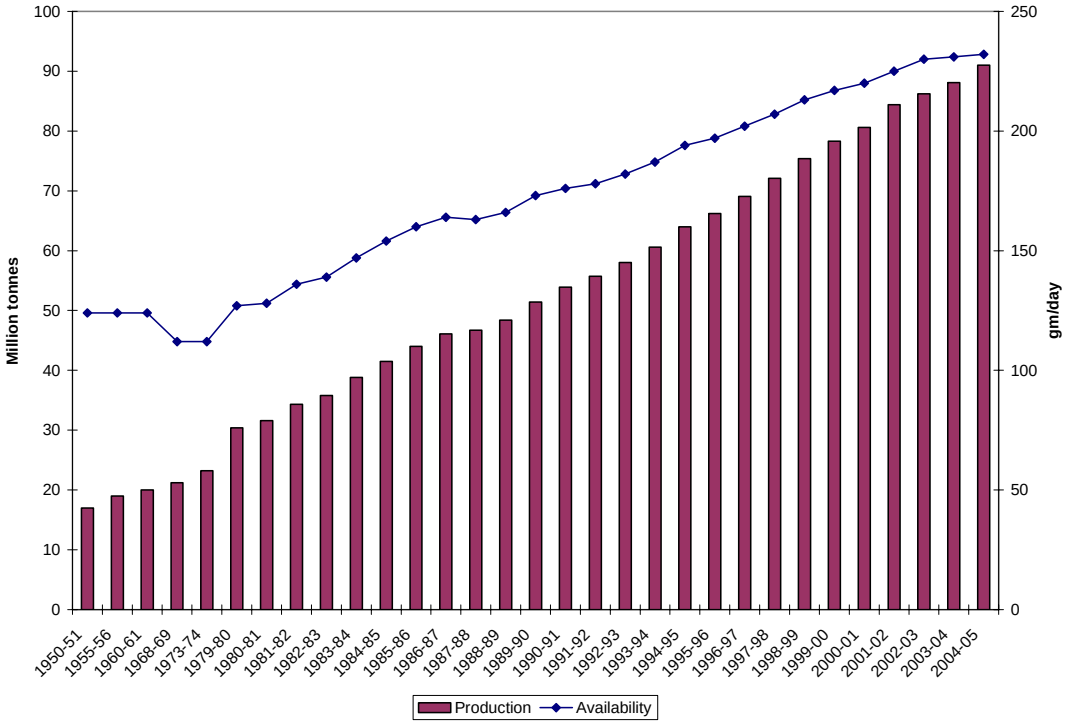


Figure 17. *Milk production and availability trends in India: 1950-51 to 2004-05*

Source: Basic Animal Husbandry Statistics (2004), Department of Animal Husbandry, Ministry of Agriculture, GOI

The strategy for organized dairy development in India was conceived in the late 1960s after the National Dairy Development Board (NDDB) was founded in 1965, and rested on the Operation Flood Programme. During the 1970s, dairy commodity surpluses were building up in Europe, and the potential was recognized for using the European surpluses as an investment in the modernization of India's dairy industry. With the assistance of the World Food Programme, food aid - in the form of milk powder and butter oil - was obtained from the countries of the European Economic Community (EEC) to finance the programme. Revenues generated from sale of the reconstituted dairy products were then reinvested in dairy development activities.

Operation Flood Programme, as the concessional import reconstitution and cooperative development scheme was called, was designed to develop dairying by replicating the Anand Model dairy development. The Anand pattern including primary village cooperative societies linked to district and state cooperative unions for milk collection and processing, and also for provision of animal health and breeding services. The first phase of Operation Flood was launched in 1970, and involved organizing dairy cooperatives at the village level; creating physical and institutional infrastructure for milk procurement, processing, marketing and production enhancement services at the district/union level and establishing dairies in India's major metropolitan centres. The initial targets were India's best milk sheds, linking them with the four main cities of Bombay, Calcutta, Delhi and Madras. The second phase of the Operation Flood Programme was implemented between 1981 and 1985. Designed to build on the foundation laid in the first phase, it integrated the Indian Dairy Association assisted dairy development projects being implemented in some Indian states into the overall programme. The third phase of Operation Flood, which was completed in 1996, aimed at ensuring that the cooperative institutions become self-sustaining, and envisaged substantial expansion of processing and marketing facilities, extended milk procurement infrastructure, increased outreach of production enhancement activities and professionalisation of management in the dairy institutions.

During Operation Flood average milk procurement through cooperatives increased from 2.56 million kg per day during Phase I to nearly 11 million kg per day during Phase III, which was only about 6-7 percent of total milk production in the country. However, there are variations in proportion of milk procured to total milk production across states. The striking pattern that emerges is the predominance of cooperatives in Gujarat and Maharashtra. In some other states, the success of the Operation Flood cooperative development was mixed, due to a variety of factors including political interference in cooperative governance, and competition from informal/traditional and private sector players.

In 1989, the Government of India launched a Technology Mission on Dairy Development (TMDD) to coordinate the input programs for the dairy sector, which ended in March 1999. An Integrated Dairy Development Programme (IDDP) in non-Operation Flood, hilly, and backward areas was launched as a Centrally Sponsored Plan Scheme during the Eighth Plan and continued during the Ninth and Tenth Plans.

Despite all these efforts, the traditional sector remained the key player in milk marketing handling about 90 percent of the total milk produced until the late 1980s. The share of formal organized sector increased to about 15 percent in late 1990s.

To promote domestic production, India adopted an import-substitution strategy and protected the sector from external markets through means such as quantitative restrictions on imports and exports and canalization (restricting imports and exports through government or government designated agencies). Competition within the formal sector was regulated through licensing provisions, which prohibited new entrants into the milk-processing sector.

Post-Operation Flood and Post-Reforms Period (1990s onwards)

The third phase of Indian dairy policy started in the early 1990s, when the Government of India introduced major economic policy reforms that favoured increasing privatization and liberalization of the economy, which included the dairy industry. The dairy industry was delicensed in 1991 with a view to encourage private sector participation and investment. The Govt. of India consequently promulgated the Milk and Milk Product Order (MMPO) in 1992. This order required that any person/dairy plant handling more than 10,000 litres per day of milk or 500 MT of milk solids per annum required to be registered with the registering authority appointed by the Central Government. Through the milk shed concept, it also gave to the cooperative sector a means to exclude private investment if it was regarded as a competitive threat. In spite of the fact that amendments to the MMPO were made from time to time in order to make it more liberal and oriented to facilitate the private dairy entrepreneurs, concerns were raised about these government controls and licensing requirements for restricting large Indian and multinational players from making significant investments in this sector. As a consequence, in 2002 restrictions on setting up milk processing and milk product manufacturing plants were removed and the concept of the controlled milk shed was also abolished, removing the advantage that had been given to the cooperative sector. This amendment is expected to facilitate the entry of large companies, which would definitely increase competition in the domestic markets.

Another major policy development in the Indian dairy sector occurred when India signed the Uruguay Round Agreement on Agriculture (URAA) in 1994 and became Member of the WTO, which committed India to open up its agriculture sector including dairy to the world markets. Till the signing of Uruguay Round, agriculture including the dairy sector received special treatment under GATT trade rules through exemption, concessions and loopholes from most of the restrictions applying to manufactured goods. As a result GATT allowed countries to implement measures disallowed for other sectors and enabled countries to maintain trade barriers. But as per the commitment under the WTO, the import and export of dairy products, which was restricted through quantitative measures (canalisation, licensing, quotas, etc.) and other non-tariff barriers, was brought under the Open General License (OGL). Imports and exports of dairy products were allowed freely by abolishing licensing requirements and canalization with certain inspection requirements. The first major step was taken in 1994-95 when import of Skim Milk Powder (SMP) and butter oil was decanalized and restrictions on the remaining products were removed from April 2002. Moreover, there has been a significant reduction in the import tariffs on dairy products after trade liberalization. However, India had bound its import tariffs for sensitive dairy products at low levels in the Uruguay Round schedules (Table 19).

Table 19. Applied and bound tariffs (%) on selected dairy products in India

	Applied as on April 2005	Bound
Fresh milk and Cream	60	100
Butter and Ghee	40	40
Cheese and curd	30	40
Milk Powder	60	15-60[6]
Yoghurt	30	150
Butter milk	30	150
Condensed milk	30	40
Dairy spreads	40	40

[6] India had committed zero bound rate of duty on milk powder, which was renegotiated with selected countries and a two-tier tariff structure (under Tariff Rate Quota TRQ) was finalized. If the imports are below 10,000 metric tons the bound rate will be 15 percent and if the imports exceed 10,000 metric tons the bound rate will be 60 percent.

Source: Easy Reference Customs Tariff 2004-05

However, the imports of these products are allowed only against a sanitary import permit issued by the country of origin.

The Indian dairy industry acquired substantial growth during the 1980s and 1990s, production of milk increased from 32 million tonnes in 1980/81 to 91 million tonnes in 2004/05. Buffalo and cow are important milch species with a share of 55 and 43 percent respectively in total milk output, and goats account for most of the rest. Growth in total milk production however has decelerated marginally from 5.3 percent during 1980s to 3.95 percent during 1990-2004. The deceleration has been observed in the case of both cow and buffalo milk production. This rapid and sustained growth in milk heralded the country into an era of self-sufficiency towards late 1990s, and dependence on imports reduced considerably. This has not only made India the number one milk producer in the world, but also represents sustained growth in the availability of milk and milk products for the burgeoning population of the country. The per capita availability of the milk has also increased to a level of about 232 gm per day, but this is still low as compared to most developed nations or the world average of 285 gm per day, but is high compared to most developing countries.

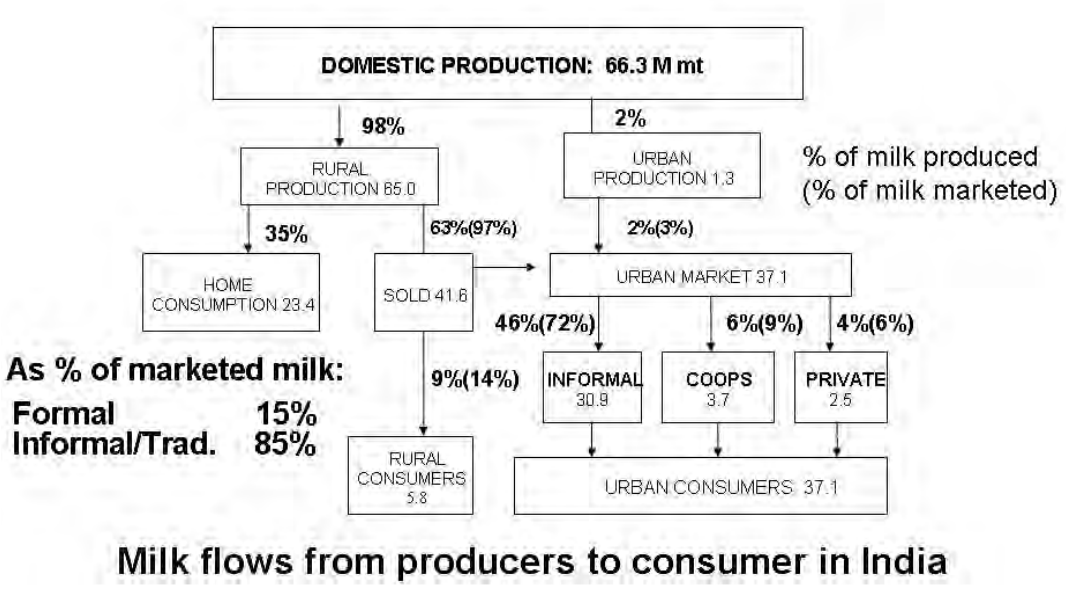


Figure 18. Comparison of milk and dairy product flows through alternative markets in India.

Source: adapted from Dairy India, 1997

However, throughout all of this period, the informal, traditional sector has dominated, and continues to play by far the largest role in the market, with a share of over 80% in the total market of milk and milk products (Dairy India, 1997, Figure 18). In spite of its dominant role in the milk market, no concrete policy measures have been undertaken so far to give fillip to, or significantly constrain, the traditional sector involved in milk marketing and production of traditional Indian dairy products, some of which have tremendous potential in the domestic and export market. Nevertheless, small scale informal market players are not completely unregulated, but are subject to state rules and regulations, which vary across states. Traditional market players are often required to obtain municipal licenses and pay the fee and other taxes where applicable, primarily based on their business activity rather than as a dairy enterprise.

In spite of the investment in cooperative development through Operation Flood and elsewhere, the share of urban milk market served by dairy cooperatives in the 1990s was only some 9 %, compared to about 72% for the traditional/informal sector. The role of the private sector has been even smaller, around 6% of the urban market. While the private sector seems to have grown since the 1990s, these relative proportions are likely to not have changed significantly, and will not for the foreseeable future.

Regulatory Environment in the Dairy Sector

The Indian dairy industry has grown and diversified enormously in the last few decades. To ensure the proper development and growth of this sector, the government has formed various laws and regulations. The regulations that govern the dairy processing industry are briefly discussed below.

Food quality and safety

Food quality and safety issues are regulated by a number of acts and agencies. The Ministry of Food and Consumer Affairs is the

main agency dealing with issues of food safety. There are other ministries/departments, which are involved in food regulations. The Prevention of Food Adulteration Act is the main food safety act enforced by the Ministry of Health and Family Welfare, Government of India. It focuses on the establishment of regulatory standards for food safety and applies equally to domestic and imported foods including livestock products. It covers various aspects of processing and distribution such as colour, preservatives, and pesticide residues, packaging, labelling and sales regulations. The Bureau of Indian Standards creates standards for food products. The Standards of Weights and Measures Act establishes fair trade practices with respect to packaged commodities, and makes it essential for the manufacturers to display information about the nature of the commodity, date of manufacture and retail price on the label.

Besides these, there are a number of commodity specific quality control orders issued under the Essential Commodities Act. Milk and Milk Products Order (MMPO) has promulgated for dairy products. This is applicable to both the domestic and imported products. The MMPO regulates the production, distribution and supply of milk products. It establishes sanitary requirements for dairy products, machinery, premises, and establishes quality standards for milk and milk products. Agricultural Products (Grading and Marketing) Act, 1937, commonly known as AGMARK is enforced by Directorate of Marketing and Inspection under the ministry of rural development. Under this Act, Grade Standards are prescribed for agricultural and allied commodities. Grading under the provisions of this Act is voluntary. Manufacturers who comply with standard laid down by DMI are allowed to use "Agmark" labels on their products.

The fact that food safety regulations are enforced by these multiple agencies and Acts is considered to be restrictive to the growth of food processing industry. Recognizing the growth potential of food processing and to create an enabling environment for value addition to agricultural products the Government of India has taken an initiative to create a Unified Food Law by merging/amending all the existing food laws taking into consideration the global food quality standards. The Unified Food Law, known as the Food safety and Standards Bill, was introduced in the legislature in August 2005 and after approval from the parliament all the prior acts/regulations related to food would be repealed. The proposed act would be implemented and coordinated by a single agency.

The export of milk like other products is governed by the section 3 of the Export (Quality Control and Inspection) Act of 1963. The Export Inspection Council (EIC) of India was established under the above act to ensure quality control of products for the export market. The EIC advises the Government on measures to be taken to enforce quality control and inspection for exports. The EIC offers export inspection and certification services under the following systems: consignment wise

inspection (CWI); in-process quality control (IPQC); or self certification. Any one or more of the systems may be specified in the notifications of individual commodities. However, milk products along with fish and egg products are subject to mandatory export certification based on Food Safety Based Management Systems (FSMSC). The FSMSC is based on international standards of food safety management systems such as HACCP/GMP/GHP and involves approval and surveillance of food processing units. The EIC is also working to develop equivalence agreements, as envisaged under the SPS Agreement, with the official import control bodies of its major trading partners.

Other Government Regulations

Industrial License

No license is required for setting up a dairy processing plant in India. Only a Memorandum has to be submitted to the Secretariat for Industrial Approvals (SIA) and an acknowledgment is to be obtained. However, certificate of registration is required under the Milk and Milk Products Control Order (MMPO) 1992.

Foreign Investment

Foreign Investment in dairying requires prior approval from the Secretariat of Industrial Approvals, Ministry of Industry, as dairying has not been included in the list of High Priority Industries. In High Priority Industries automatic approval is given up to 51 percent foreign investment, while in case of other industries, proposals are cleared on case to case basis. Government may allow 51 percent without enforcing the old limit of 40 percent applicable under Foreign Exchange Regulations Act at its discretion.

Foreign Technology Agreements

Foreign Technology Agreements are freely allowed in high priority industries under certain conditions, whereas Foreign Technology Agreements in dairying need prior approval.

Import of Capital Goods

Import of capital goods is automatically allowed if it is financed through Foreign Equity. Alternatively, approval is needed from the Secretariat of Industrial Approvals. The approval depends on the availability of Foreign Exchange Resources. Import of Second hand goods is allowed subject to the following conditions:

i. Minimum Residual life of 5 years and the equipment should not be more than seven years old.

ii. A certificate from the Chartered Engineers of the country of origin certifying the age and the Residual life is to be produced.

iii. Import will be allowed only for actual users.

Export promotion: The Agricultural and Processed Food Products Export Development Authority (APEDA) is responsible for the promotion and regulation of exports of agricultural products including livestock products. It provides support for export promotion and market development, strengthening of market intelligence and information channels, development of infrastructure and human resource capacity, modernization of processing facilities etc.

A new scheme called the Vishesh Krishi Upaj Yojana (Special Agricultural Produce Scheme) for promoting the export of agricultural products has been introduced in the Foreign Trade Policy (FTP) 2004-09. The scheme has been extended to dairy/poultry and their value-added products in the FTP 2005-06. Under this scheme, the exports of milk products are eligible for interest free export credit of 5% value of their export. This scheme has not made much dent in the export of milk products and it is felt that the level of incentive is not adequate.

Further, the Government of India provides Duty Drawback on products and goods exported by Indian manufacturers and merchant exporters on agro and milk products at varying rates. Although, skimmed milk powder, full cream milk powder and casein are made from milk, the duty drawback benefit of 14 percent is allowed on casein alone. This has put SMP and WMP in a disadvantageous position in the export market.

Trade in Dairy Products

Despite being the largest producer of milk in the world, India is a very small player in the world market. India had very little experience in the international trade of dairy products prior to the 1990s. Until the early seventies most of the demand-supply gap of liquid milk requirement for urban consumers was met by reconstituting imported butter/butter oil and milk powders. India started exporting surplus dairy commodities, such as milk powders, *ghee* and butter, in the 1990s. However, the exports of dairy products from India are negligible compared to both its own production and to international trade. The import and export of dairy products was regulated through the Agricultural and Processed Food Products Development Authority till early 1990, however, in 2001 the government removed these restrictions and allowed free trade of most of the dairy products. India's dairy product exports are occasional and primarily in the flush season. Although India exports a wide variety of dairy products, skim milk powder (63.3%), ghee and butter oil (11.7%), and whole milk powder (7.3%) remain the major export items. The exports of skim milk powder increased from 130 tonnes 1990-91 to as high as 6,000 in 1994-95, but fell to 1,350 tonnes in 1997-98. These relatively very

small export figures clearly demonstrate that Indian exports are still in its infancy, although integration into global markets under WTO offers opportunities for increased dairy exports.

Livestock Population Trends

India has one of the largest livestock populations in the world accounting for about 57 per cent of the world buffalo population and 16 per cent of the cattle population (GOI, 2002). The growth pattern of livestock population between 1951 and 2003 is given in Table 20. The cattle population that had been increasing until 1992 has started declining. The turning point in the composition of draft animal population was 1977 to 1982, when male cattle population declined by over 12 million and the male buffalo population declined by some 2 million. Between 1992 and 2003 the cattle population declined by 9 percent. The decline is confined to indigenous stock that comprised 87 percent of the total cattle population in 2003. The number of indigenous cattle declined by 15 percent, while that of crossbred increased by 62 percent[7]. Within the indigenous stock, the decline was particularly drastic for males (22%). Main reasons for decline in indigenous cattle are: increasing substitution of draught animals with mechanical power and low milk yield.. This declining trend, however, is not uniform across the states with agriculturally advanced and more mechanized states (e.g. Punjab, Haryana, Andhra Pradesh, Kerala, Tamil Nadu) witnessing a sharper decline in working male population while the less progressive and hilly states like Assam, Bihar, Madhya Pradesh, Orissa, West Bengal showed increasing dependence on work animals. The population of buffaloes increased from 43.2 million in 1951 to 93 million in 2003, although growth in the buffalo population decelerated from around 2 percent during 1970s and 1980s to around 1.2 percent afterwards. This is on account of faster deceleration in the growth of male buffalo population, which fell to 0.3 percent during the latter period from 0.7 percent. The proportion of females among the buffalo population has been increasing consistently and in 2003 accounted for about 55 percent.

The cattle crossbreeding programme, after an initial slow start during the 1960s, spread consistently and the population of crossbred cattle has consequently been increasing over time. The number of artificial inseminations has gone up significantly from nearly one million in early 1970s to about 27 million in late 1990s. The present production capacity of frozen semen doses is about 30 million against the estimated requirement of 65 million doses annually.

The share of crossbreds in the total cattle population increased from 4.6 percent in 1982 to 10.1 percent in 1997, and 13.3 percent in 2003. Within these national trends there are significant regional variations. Crossbred cattle accounts for over 50 percent of total cattle in Punjab, Kerala, Tamilnadu, Sikkim and Nagaland, 25-50 percent in Haryana, Himachal Pradesh, Jammu & Kashmir and Mizoram and 10-25 percent in Maharashtra, Bihar, Goa, Karnataka and Manipur. In rest of the states it is less than 10 percent. Apart from the introduction of exotic germplasm in cattle breeding, the native high-yielding Murrah buffalo has been widely used for upgrading the low-producing buffalo breeds in different regions of the country.

Animal Health, Feeds & Fodder Policies

With the improvement in the quality of livestock through the extensive cross breeding programmes, the susceptibility of these stocks to various diseases including exotic diseases has increased. In order to reduce morbidity and mortality, efforts have been made to control animal diseases namely, Rinderpest, Foot and Mouth Disease, Haemorrhagic Septicemia, Black Quarter, and Anthrax since the Second Five Year Plan. Although Rinderpest has been eradicated from the country, the prevalence of other diseases continues to be one of the major problems. The programmed or creation of disease free zone was sanctioned in the Ninth Plan but was not implemented. There were only 1450 veterinary hospitals and dispensaries before the beginning of the First Five Year Plan, which increased to a net work of 26,717 Polyclinics/Hospitals/ Dispensaries and 28,195 Veterinary aid centres (including Stockmen Centres/mobile dispensaries). These are supported by about 250 disease diagnostic laboratories, which are functioning in the States and Union Territories for quick and reliable diagnosis of diseases. A network of disease diagnostic laboratories is being put in place to collect information on prevalence of diseases, provide diagnostic services to help in control and eradication of diseases. However, there is no evidence of a significant decline in the disease incidence, which may be attributed to lack of emphasis on prophylactic measures.

Table 20. Growth pattern of livestock population in India: 1951-1992 (million)

Species	1951	1956	1961	1966	1972	1977	1982	1987	1992	1997	200
Cattle	155.3	158.7	175.6	176.2	178.3	180.0	192.5	199.7	204.6	198.9	178.
Adult female cattle	54.4	47.3	51.0	51.8	53.4	54.6	59.21	62.07	64.36	64.4	59.2

[7] Cross breeds are defined as crosses of exotic cattle with indigenous cattle.

Buffalo	43.4	44.9	51.2	53.0	57.4	62.0	69.78	75.97	84.21	89.9	93.2
Adult female buffalo	21.0	21.7	24.3	25.4	28.6	31.3	32.5	39.13	43.81	46.8	51.0
Total bovines	198.7	203.6	226.8	229.2	235.7	242.0	262.4	257.8	289.0	288.8	272.
Total livestock	292.8	306.6	335.4	344.1	353.4	369.0	419.6	445.3	470.9	485.4	464.

Growth rate (%/year)	**1951-56**	**1956-61**	**1961-66**	**1966-72**	**1972-77**	**1977-82**	**1982-87**	**1987-92**	**1992-97**	**199 03**
Cattle	0.43	2.04	0.07	0.24	0.19	1.35	0.74	0.48	-0.56	-1.7
Adult female	-2.76	1.52	0.31	0.61	0.45	1.63	0.95	0.73	0.02	-1.4
Buffalo	0.68	2.66	0.69	1.61	1.55	2.39	1.71	2.08	1.32	0.6
Adult female buffalo	0.66	2.29	0.89	2.40	1.82	0.76	3.78	2.28	1.12	1.4
Total bovines	0.49	2.18	0.21	0.56	0.53	1.63	1.01	0.94	-0.01	-1.0
Total livestock	0.93	1.81	0.51	0.53	0.87	2.60	1.20	1.12	0.65-	-0.7

Source: *Basic Animal Husbandry Statistics 2002, Department of Animal Husbandry and Dairying, Ministry of Agriculture, Government of India;17th Livestock Census (2003), Department of Animal Husbandry and Dairying, Ministry of Agriculture, Government of India*

Adequate supply of feed and fodders is essentially for enhancing the productivity in dairy sector. Though production of high quality fodder seeds has been a major focus area since the early 1950s, India has been chronically deficit in feed and fodders. Animal feed production is mainly concentrated in the private sector, however, cooperatives also manufacture and supply feed to the farmers. The quality control measures for animal feed are not very effective so there has always an issue of poor quality of feeds.

According to the Tenth Five Year Plan Document, most of the livestock services like artificial insemination/natural service, vaccination, de-worming, etc. are time-sensitive, which government institutions, at times, are not able to deliver due to financial as well as bureaucratic constraints. This necessitates the provision for efficient and effective decentralized services in tune with demands from users. The government has emphasized the need for providing such services at the farmers' door and linked with cost recovery for economic viability as the large share of budgets is spent on the wages and administrative costs.

Changing Demand Patterns for Dairy Products

Despite being the largest milk producer in the world, per capita availability and consumption of milk in India is still relatively low, although it is high by developing country standards. The per capita availability of milk, which declined during the 1950s and 1960s (from 124 gm per day in 1950-51 to 121 gm in 1973-74) expanded substantially during the 1980s and 1990s and reached about 232 gm per day in 2004-05. Between 1983 and 1999-00*, per capita annual milk consumption increased from 43 kg to about 74 kg (Table 21). However, there is considerable variation in consumption of milk across income classes, and strong positive association between quantity of milk consumed and income level.

Table 21. Per capita consumption of milk* and share of consumer expenditure spent on milk & milk products (Kg/capita/annum)

	Rural	Urban	All
1983	37.0	55.5	43.0
1987-88	49.4	64.6	54.4
1993-94	54.7	65.2	58.6
1999-00	63.3	90.7	73.5
Share of milk and milk products in household consumption expenditure (%)			

* Consumption data available only up to 1999-00.

1983	7.6	9.5	8.4
1987-88	9.0	9.7	9.3
1993-94	9.7	9.6	9.6
1999-00	9.0	8.9	8.9

* includes milk and milk products (converted into milk equivalent). Source: Kumar and Birthal (2004)

Milk is consumed in a variety of forms, either as liquid milk or as processed products, such as *ghee*, *curd*, butter, sweets etc. But the milk utilization pattern in the country has changed over the years (Figure 19). The share of liquid milk in total milk consumption increased from 39.3 per cent in 1951 to 45.7 per cent in 1995, whereas the share of *ghee* (clarified butter) has declined from 39.3 per cent to about 27.5 per cent during the same period. The share of other products showed a significant increase from barely 2 per cent in 1951 to about 7 per cent in 1995, which might be attributed to an increase in production of western dairy products like ice cream, cheese, chocolates, milk powders and other dairy based products. As may be observed, the market is shifting in favour of cheese, butter, and other products and against *ghee*. Demand for traditional dairy products like *paneer, chhena, khoa, gulab jamun*, etc. has increased, and modern formal processors, recognizing the powerful demand for traditional products, have increasingly entered into these markets, in competition with the small scale traditional sector.

Several factors have contributed to the increased demand for milk and dairy products in the country, including the strong cultural significance of milk in the India where a large proportion of population is lacto-vegetarian. The demand for milk and dairy products is income elastic, and growth in per capita income is expected to increase demand for milk and milk products, and urbanization and changing food habits and lifestyles, have also reinforced growth in demand for dairy products. Further, per capita consumption of milk is 1.5 times higher among the urban households compared to rural households. Nevertheless, the per capita consumption of milk has been increasing faster in the rural areas. Between 1983 and 1999 consumption of milk increased by 71 percent in rural households and 63 percent in urban households. This suggests that though urbanization would remain a key driver of demand, sustained growth in rural income would fuel rapid growth in rural demand for livestock products.

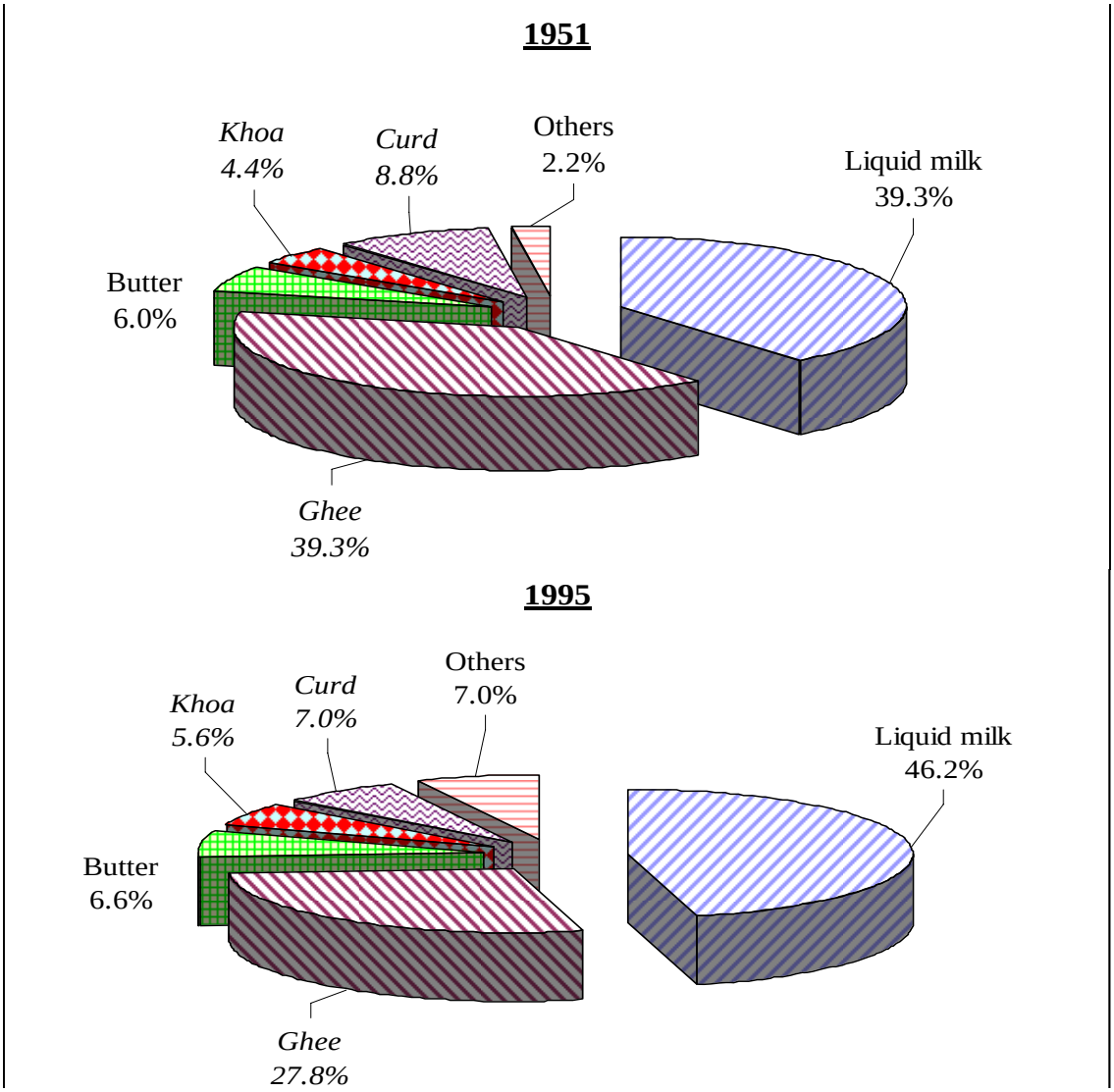
In 1999-2000 livestock products accounted for 12.92 percent of the total household consumption expenditure of rural households. This is slightly higher than that of urban households (12.65%). In rural areas, the share of livestock products increased from 11.0 percent in 1983 to 13.1 percent in 1987-88 and to 13.9 percent in 1993-94 and then slightly declined to 12.9 percent. In urban areas, however it increased slightly during 1980s, but declined during 1990s. Both the rural and urban consumers spent about 70 percent of the total allocation to livestock products on milk and dairy products.

Given the relatively high income elasticity, the demand for milk and dairy products is expected to grow rapidly. A study conducted by Saxena (2000) using National Sample Survey (NSS) data for 1993-94 showed that the income elasticity of demand for milk and milk products is higher (1.96 national level) in rural areas (ranging from 1.24 in Punjab to 2.92 in Orissa) than in urban areas (ranging from 0.99 in Punjab to 1.78 in Bihar). Further increases in per capita income and changing consumption patterns would lead to acceleration in demand for milk and other livestock products in India and thus would give a boost to this sector. Some other estimates are shown in Table 22.

Table 22. Income/expenditure elasticity of demand for milk in India

	Rural	Urban	Demand for milk by 2020 (million tonnes)
Radhakrishna & Ravi (1992)	1.15	0.99	-
Gandhi and Mani (1995)	1.70	1.06	-
Kumar (1998)	-	-	126.0 - 182.8[@]
Saxena (2000)	1.96	1.32	85.7[#]
Delgado, *et. al.* (2001)	-	-	132.0
Dastagiri (2001)	1.36	1.07	147.21

***Note**: [#]: Estimates for 2007-08; [@]: Estimates based on 4% growth in GDP (126.0), 5% growth (142.7) and 7% growth in GDP (182.8);*



Source: *Dairy India (1997)*

Figure 19. Changes in milk utilization patterns in India, 1951 and 1995

Analysis of regional differences in dairy development in India

In this section, a comparison of dairy development across states and districts within states in India is conducted in order to determine what factors explain differences in development (commercialization) of the dairy sector. First, a comparative analysis is performed to find differences in the levels of different factors affecting development of the dairy sector in different states. This is complemented by a regression analysis using a database containing information for districts within ten states and three years (1982, 1987 and 1992).

Comparing dairy development across states

To compare dairy development regionally, a data set with information for the years 1972, 1977, 1982, 1987, 1992 and 1997 is used. The information is available at the district level but not all districts are available in all states, so the figures presented do not necessarily represent total values for the state but only for districts available. Although the dataset covers 10 states and approximately 250 districts, the total number of variables in this dataset is limited, and only a partial picture of some of the main factors affecting the development of the dairy sector can be presented. One of the main limitations of the dataset is that figures of milk production are only given for two years (1982 and

1997) and for some of the states. Because of this, an indicator of development of the dairy sector that does not use production figures was defined.

Using a variation of the discussion in the Conceptual Framework, development of the livestock sector can be associated with *increased production per agricultural worker*. At early stages of development, the number of animals per worker would increase as smallholders increase their animal stock. Later in the process, increased production per animal and decreasing number of agricultural workers should keep the growing trend of milk production per worker. If this is the case, then the number of milking animals per worker is not a good indicator of development given that it can decrease while productivity grows. In fact, this is what happened in India in the past years[8].

Even if the total number of milking animals per worker is decreasing there might be differences in growth in different species and animal types. The analysis of the data shows that decreases in the number of milking animals per worker are explained by decreases in the number of milking cows, while the number of milking buffalos is growing. The other growing category in the animal stock is the number of hybrid cows, which captures changes in productivity and reflects growth in output per worker. A larger number of hybrid cows per worker would reflect a more commercialised dairy sector; one using improved technologies and producing more milk per agricultural worker. An indicator using number of hybrid cows and number of milking buffalos per worker might better capture the expansion of the dairy sector if, for example, growth of the dairy sector in some regions is based on the expansion of milking buffalos while in others growth occurs through technical change and the expansion of genetically improved cattle.

Based on this, we define an index that combines the number of hybrid cows with the number of milking buffalos per worker in agriculture to be used as our indicator of development of the dairy sector[9]. Independent variables included in the analysis relate to developments of the crop sector, population density, literacy, labour market, and infrastructure, income and policy, following the Conceptual Framework.

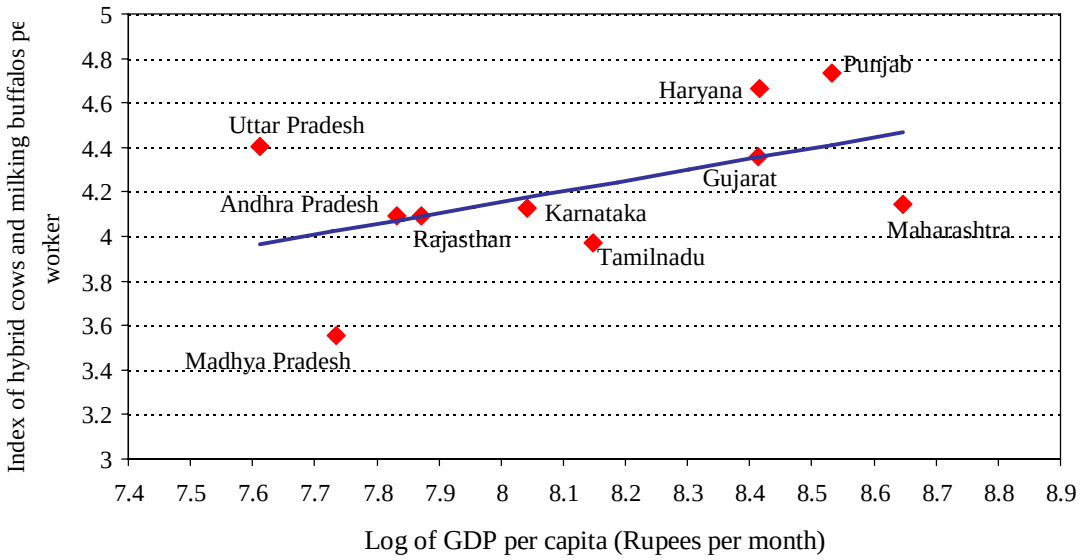


Figure 20. Index of the number of hybrid cows and milking buffalos per worker as a measure of development of the dairy sector plotted against GDP per capita

[8] Regressing the log of the number of milking animals per worker against a time trend we obtain a negative and significant coefficient, showing that the number of milking animals per worker is decreasing through time in our sample.

[9] The index is calculated assigning numbers from 1 to N to the district with lowest and highest number of hybrid cows per worker in agriculture respectively, and repeating this for the number of milking buffalos so that each district has two numbers assigned: one for the number of milking buffalos and one for the number of hybrid cows per worker. The final index results from adding these two numbers which means that hybrid cows and milking buffalos contribute to the index with equal weight.

Figure 20 shows the relationship between GDP per capita of the states included in the analysis and the index of the number of hybrid cows and milking buffalos per worker. As expected, there is a positive and statistically significant relationship between these two variables. Punjab and Haryana appear to have the larger number of hybrid cows and milking buffalos per worker and they are within the group of four states with the highest income per capita (Punjab, Haryana, Maharashtra and Gujarat). Tamilnadu and Karnataka have also a relatively high income although below the group of four states mentioned above. The poorest states in our sample are Andhra Pradesh, Maydha Pradesh, Uttar Pradesh and Rajasthan.

The relationship between the number of hybrid cows and milking buffalos per agricultural worker and income shows that Gujarat, Karnataka, Rajasthan and Andhra Pradesh have values for this indicator that are close to what is expected according to their level of income (Figure 20). Punjab, Haryana, and specially Uttar Pradesh appear to have a more developed dairy sector than expected, while Maharashtra, Tamilnadu and Madhya Pradesh have a less developed dairy sector than expected according to their respective incomes.

Table 7 compares information for the states included in this analysis to explain differences in development of the dairy sector across states. Two groups of states were defined according to the value of the index of hybrid cows and milking buffalos per worker: Punjab, Haryana, Uttar Pradesh and Gujarat show the higher values for this indicator (Group 1). While Table 7 presents values for several variables for each state, Table 8 shows averages for each group and variable. The difference between the average values of the variables in groups 1 and 2 (in percentage) is presented in the last column of Table 8.

Table 7. Indicator of development of the dairy sector and variables affecting development for different states grouped by level of development indicator (Index of the number of hybrid cows and milking buffalos per worker in agriculture)

	Group 1					Group 2				
Variable	**Punjab**	**Haryana**	**UttarP**	**Gujarat**	**Maharashtra**	**Karnataka**	**Rajasthan**	**AndhraP**	**Tamilnadu**	**MadhyaP**
Index hybrid cows + milking buffalos/worker	114	106	82	78	63	62	60	60	53	35
Hybrid cows/worker	0.47	0.28	0.09	0.03	0.1	0.06	0.01	0.03	0.14	0.01
Milking buffalos/worker	0.979	0.711	0.324	0.388	0.159	0.211	0.407	0.236	0.108	0.185
Urbanization	30	25	20	34	39	31	23	27	34	23
GDP per capita (Rupees/month)	5079	4516	2023	4505	5690	3109	2621	2521	3454	2286
Annual growth of GDP per capita (%)	2.8	2.6	1.6	7.8	6.8	3.5	4.4	3.7	5	3.9
Population density	3.27	3.26	3.67	1.78	1.76	1.91	1.1	1.93	3.43	1.16
Rural workers/population	0.2	0.2	0.27	0.23	0.33	0.29	0.28	0.36	0.29	0.36
Road density (km per hectare)	8.81	5.22	2.55	3.59	5.3	7.08	1.94	5.31	12.4	2.14
Crop area under irrigation (%)	762	634	380	142	80	115	147	147	208	108
Fertilizer per hectare of crops (kgs)	238	190	73	39	37	43	16	55	67	18
Literacy rate (%)	42	40	28	42	43	38	23	29	47	28
Cattle/Buffalo	0.31	0.34	0.67	0.67	1.84	1.66	1.08	0.53	2.1	2.5
Milking animals/stock	0.51	0.36	0.34	0.41	0.36	0.34	0.41	0.34	0.35	0.33
Rain (mm per year)	901	602	1086	793	1145	1170	642	878	998	1205

Table 8. Average values for the indicator of development of the dairy sector and variables affecting development for two groups of states

Variable	Group 1[a/]	Group 2	G1 - G2 (%)
Hybrid cows/worker	0.22	0.06	279
Milking buffalos/worker	0.60	0.22	176
Index hybrid cows + milking buffalos/worker	95.00	55.50	71
Urbanization	27.25	29.50	-8
GDP per capita (Rupees/month)	4030.75	3280.17	23
Annual growth of GDP per capita (%)	3.70	4.55	-19
Population density	3.00	1.88	59
Rural workers/population	0.23	0.32	-29
Road density (km per hectare)	5.04	5.70	-11
Crop area under irrigation (%)	479.50	134.17	257
Fertilizer per hectare of crops (kgs.)	135.00	39.33	243
Literacy rate (%)	38.00	34.67	10
Cattle/Buffalo	0.50	1.62	-69
Milking animals/stock	0.41	0.36	14
Rain (mm per year)	845.50	1006.33	-16

Notes: Group 1 is the group of states with highest number of hybrid cows and milking buffalos per worker in agriculture

Major differences between groups 1 and 2 are revealed in irrigation, and in the use of fertilizer. Smaller but still significant differences occur in the proportion of milking buffalos to milking cattle, and population density. These results suggest that development of the crop sector and the infrastructure related with this development during the period of the Green Revolution have played a key role in the development of the dairy sector. Punjab and Haryana, with the largest value of the dairy development index and the highest income per capita were at the epicentre of the Green Revolution, which also extended although in a lesser degree, to Maharashtra, Gujarat and parts of Uttar Pradesh. Tamil Nadu in the South benefited from high-yielding rice varieties. The poor states of Andhra Pradesh, Madhya Pradesh, and Rajasthan did not benefit as much from the period of agricultural-lead growth, showing the less developed dairy sector and the lowest income per capita, although they have the agro-climatic potential (at least in part of their territory) to yield high returns in agriculture according to Sachs et al (2002).

It is important to notice that development of the crop sector and infrastructure affects dairy sector from both the supply and demand side. The Green Revolution states with better infrastructure and high crop production are more likely to have better developed markets for feed (lower transaction costs). This development of the crop sector is also associated with higher income and higher demand for dairy products.

Two interesting comparisons are those between Uttar Pradesh and Madhya Pradesh, and between Gujarat and Haryana. Uttar Pradesh is the poorest state in our sample with a relatively developed dairy sector given its level of income; while Madhya Pradesh has a similar income to Uttar Pradesh but the least developed dairy sector in our group of states. Gujarat and Haryana are states with high income per capita with Haryana showing a less developed dairy sector.

Table 9 summarizes the results of these comparisons. The value of the dairy development index, the number of hybrid cows and the number of milking buffalos per worker in Uttar Pradesh are 134, 682 and 75 percent higher respectively than in Madhya Pradesh, even though it is the state with the lowest income per capita and has similar levels of urbanization and infrastructure than Madhya Pradesh. However, hectares under irrigation and the use of fertilizer are three to four times larger in Uttar Pradesh than in Madhya Pradesh, showing again the importance of development of the crop sector as a factor explaining development of the dairy sector. On the other hand, Punjab shows a value of the dairy development index 81 percent higher than that for Maharashtra and has 374 and 515 percent more hybrid cows and milking buffalos per worker, while at the same time shows larger irrigated area and fertilizer use than Maharashtra.

Table 9. Comparison of values for the indicator of development of the dairy sector and variables affecting development between Punjab and Maharashtra and Uttar Pradesh and Madhya Pradesh

	Comparison Punjab-Maharashtra			Comparison Uttar Pradesh - Madhya Pradesh		
	Punjab	Maharashtra	Punjab-Maharashtra (%)	Uttar Pradesh	Madhya Pradesh	Uttar P. - Madhya P (%)
Index hybrid cows + milking buffalos/worker	114.00	63.00	81	82.00	35.00	134
Hybrid cows/worker	0.47	0.10	374	0.09	0.01	682
Milking buffalos/worker	0.98	0.16	515	0.32	0.19	75
Urbanization	30.00	39.00	-23	20.00	23.00	-13
GDP per capita (Rupees/month)	5079	5690	-11	2023	2286	-12
Annual growth of GDP per capita (%)	2.80	6.80	-59	1.60	3.90	-59
Population density	3.27	1.76	86	3.67	1.16	216
Rural workers/population	0.20	0.33	-39	0.27	0.36	-25
Road density (km per hectare)	8.81	5.30	66	2.55	2.14	19
Crop area under irrigation (%)	762	80	853	380	108	252
Fertilizer per hectare of crops (kgs)	238	37	543	73	18	306
Literacy rate (%)	42	43	-2	28	28	0
Cattle/Buffalo	0.31	1.84	-83	0.67	2.50	-73
Milking animals/stock	0.51	0.36	42	0.34	0.33	3
Rain (mm per year)	901	1145	-21	1086	1205	-10

Results so far show that developments in the crop sector, which are attributed to the Green Revolution, have played a key role in boosting the development of India's dairy sector. As a result, states with more developed crop sectors, higher use of fertilizers and larger irrigated crop areas, have more developed dairy sectors.

However, our analysis has not considered the role of policy in the development of the sector, which starting with Operation Flood in 1970-1971 should have played a major role in this process. In order to include the policy and institutional dimension in the analysis, a second data set is used to study the effect of cooperatives on dairy sector development. This data set includes information on the average quantity of milk procured by cooperatives (in litres per day) for the year 1997, for which data were available. Only districts with information on milk procured by cooperatives are included in this database.

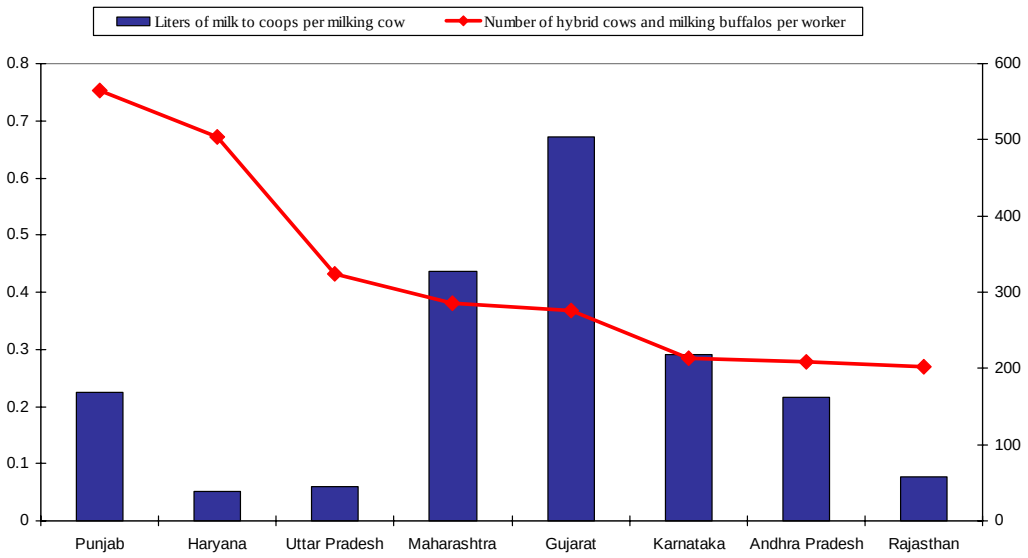


Figure 21. Milk procured to cooperatives and development of the dairy sector measured as number of hybrid cows per worker in agriculture by state

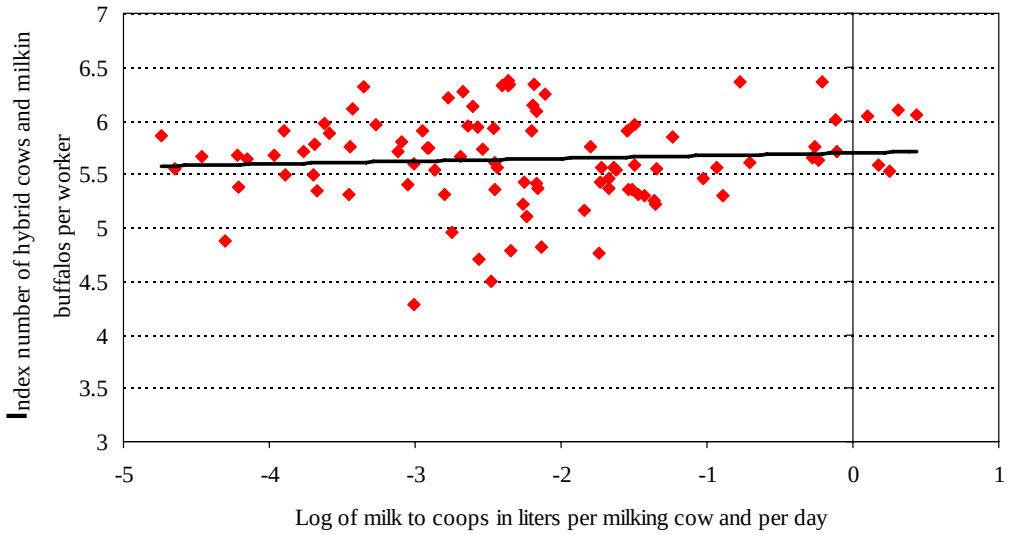


Figure 22. Relationship between milk procured by cooperatives and development of the dairy sector measured as an index of the number of hybrid cows and milking buffalos per worker in agriculture (district level)

The quantity of milk procured to cooperatives per milking animal (Figure 21) provides a measure of the importance of cooperatives in each state. Gujarat, Maharashtra and Karnataka followed by Andhra Pradesh and Punjab are the states where most milk is procured by cooperatives, while Haryana, Uttar Pradesh and Rajasthan rank the lowest among the states. No information was available for Tamilnadu and Madhya Pradesh.

Figure 21 does not show a clear relationship between development of the dairy sector and milk procured by cooperatives. In order to assess this relationship, Figure 22 plots the average quantity of milk procured by cooperatives per milking animal (in litres) against the index of hybrid animals and milking buffalos per agricultural worker at the district level. Data used are for 250 districts in the states shown in Figure 21. The results suggest that there is a small but positive relationship between milk procured by cooperatives and the indicator of dairy development. However, this result is not consistent, as demonstrated by the data for Punjab, Haryana and Uttar Pradesh, which have the highest levels of improved dairy animals, yet relatively low levels of dairy cooperative activity.

Table 10. Parameter estimates for dairy development in Indian district level information for years 1982, 1987, and 1992, three different dependent variables

	Dependent Variable		
	Index hybrid cows-milking buffalos per worker	Hybrid cows per worker	Milking buffalos per worker
	Estimated coefficient	Estimated coefficient	Estimated coefficient
Fertilizer per hectare of crops (kgs)	0.07**	0.40**	0.07**
Road density (km per hectare)	-0.07*	0.13	-0.02
Population density	-0.02	0.52**	0.01
Crop area under irrigation (%)	0.15**	-0.08	0.19**
GDP per capita	0.19	0.11	0.27
Urbanization (%)	0.93	1.41	-0.01
Annual growth of GDP per capita	-0.01	0.77**	-0.04
Rural workers/population	-0.44**	-0.40**	-0.72**
Literacy rate (%)	-0.03	0.21	-0.10
Milking cows/total cattle	0.06	0.54**	-0.24**
Hybrid/milking cow	0.13**	-	-0.07**
Milking buffalos/total buffalos	0.56**	-0.50**	1.07**
Rain (mm per year)	0.06*	-0.01	-0.06
Trend	-0.01	0.00	0.00
Dummy 1990s	0.05	0.02	0.12*
Policy dummy [a/]	0.00	-0.03	-0.03
Andhra Pradesh	-0.13	-0.84*	-0.30*
Gujarat	-0.11	-1.57**	0.03
Haryana	0.41**	0.85*	0.83**
Karnataka	-0.05	0.36	-0.19
Madhya Pradesh	0.08	-0.70	-0.25
Maharashtra	-0.16	-0.06	-0.12
Punjab	0.13	2.01**	1.29**
Rajasthan	0.21	-1.17	-0.05
Tamilnadu	-0.46	0.01	-0.89**
Constant [b/]	28.33	-16.36	5.51
R^2	0.76	0.66	0.75

Notes: a/ Takes value of 1 for the year 1992 and for states conducting macro policy reforms according to Sachs et al (2002). b/ Constant term represents the average effect of all regions. Effects of states on dairy production are obtained by adding the state coefficient and the constant term

Determinants of dairy development

Information available for districts in several Indian states does not cover all variables affecting developing of the dairy sector but gives a partial picture of some of the main factors affecting this development. In this section, a regression analysis is conducted relating the indicator of development of the dairy sector used in the previous section to some of the factors affecting this development. Total number of observations in our database is 670, covering information for districts in 10 states and three years (1982, 1987 and 1992). The dependent variable as defined above was

regressed against variables representing development of the crop sector, infrastructure, literacy, labour market, climate, stock composition, urbanization, income and dummy variables that capture changes in policy. Given that data on cooperatives were available only for some of the districts, a second database was used to regress the dependent variable against a similar set of independent variables but also including a new variable measuring the importance of cooperatives in the dairy sector of the different districts. This database covers the same years than the first database but includes a smaller number of districts in most states and no information for Tamilnadu and Madhya Pradesh. The total number of observations in this database is 294.

Table 10 presents the result of the first regression using the log of the index of hybrid animals and milking buffalos per worker in agriculture as the dependent variable for the years 1982, 1987 and 1992. The table also presents the results of regressing the number of hybrid cows and the number of milking buffalos per worker using the same set of independent variables. According to our results, the main factors contributing to development of the dairy sector are: development of the crop sector as reflected in the significance of the coefficients for irrigation and fertilizer use; the proportion of hybrid cows in total milking cows and the proportion of milking buffalos in total number of buffalos. The relationship between dairy development and the ratio of agricultural workers to total population is negative and significant. A negative relationship also occurs between the dependent variable and road density.

GDP per capita, urbanisation, the ratio of milking cows/cattle and rain are positively related to the dependent variable, while population density, GDP growth, and literacy show a negative relationship with the dependent variable. However, in all cases the coefficients are not statistically significant.

Policy changes at the macro level during the 1990s are introduced in the analysis in the form of a dummy variable defined with a value of one for the year 1992 and only for the reform oriented states (Maharashtra, Tamilnadu, Gujarat, Karnataka and Andhra Pradesh as described in Sachs et al.(2002) and zero otherwise. A similar dummy variable but including all states instead of only the reform oriented states is introduced to capture the impact of the post Operation Flood period. Both coefficients are positive but not statistically significant meaning that differential effects of the economic environment on the dairy sector cannot be detected with this database.

Finally, dummy variables are defined assigning a value of 1 when the district belongs to a particular state and zero otherwise to capture a state effect on dairy production. The dummy variable for Uttar Pradesh is dropped for estimation and the constant term represents the average of all states, so that significant coefficients for the states should be interpreted as differences with respect to the average of all states.

Results for the regressions of number of hybrid cows per worker and number of milking buffalo per worker show similar results to those in the first regression. The number of hybrid cows per worker is positively and significantly related to population density and annual growth in income while the number of milking buffalos is not, which explains the non significant coefficients of these variables in the first regression. The number of hybrid cows per worker is negatively related to the proportion of milking buffalos in total buffalo stock and similarly, the number of milking buffalos is negatively related to the ratio milking cows/cattle and hybrid cows/milking cows.

Table 23. Parameter estimates for dairy development, including role of cooperatives, from Indian district level information for years 1982, 1987, and 1992, for three different dependent variables.

	Dependent Variable		
	Index hybrid cows-milking buffalos per worker	Hybrid cows per worker	Milking buffalos per worker
	Coefficient	Coefficient	Coefficient
Fertilizer per hectare of crops (kgs)	-0.04**	0.08	-0.06**
Road density (km per hectare)	0.03	0.43	0.05
Population density	-0.04	0.30*	0.06
Crop area under irrigation (%)	0.22**	0.15	0.29**
GDP per capita	0.26	0.26	0.33
Urbanization (%)	0.23	0.76	-0.73
Annual growth of GDP per capita	0.01	0.93**	-0.02
Rural workers/population	-0.25**	0.48	-0.47**

Literacy rate (%)	0.09	-0.38	0.19*
Milking cows/total cattle	-0.04	1.35**	-0.44**
Hybrid/milking cow	0.14**	-	-0.09**
Milking buffalos/total buffalos	0.40**	0.34	0.66**
Milk procured by cooperatives [a/]	-0.01	0.24**	0.01
Rain (mm per year)	0.04	0.66**	-0.16*
Trend	-0.01	0.03	0.01
Dummy 1990s	0.07	-0.38	0.14
Andhra Pradesh	-0.30**	-1.47**	-0.45**
Gujarat	-0.05	-1.72**	-0.01
Haryana	0.41**	1.98**	0.66**
Karnataka	-0.29**	-0.23	-0.43**
Punjab	0.48**	2.22**	1.36**
Rajasthan	-0.07	-2.06**	-0.44**
Constant [b/]	17.97	-59.14	-17.24
R^2	0.78	0.67	0.69

Notes: a/ Calculated as litres of milk procured by cooperatives per day and per milking animal. Value only for 1997 so variable is defined as a constant term for each district . b/ Constant term represents the average effect of all regions. Effects of states on dairy production are obtained by adding the state coefficient and the constant term

The results confirm the importance of the development of the crop sector on dairy development, as discussed in the previous section, together with development of the labour market and increases in the opportunity cost of labour. Results also show that there appear to be two strategies to expand output per worker of the dairy sector: one based on increasing the number of milking buffalos and the second one based on the expansion of hybrid cows and technical change associated with this expansion.

To account for the impact of cooperatives in dairy development, a variable is introduced, which measures the average quantity of milk procured by cooperatives (in litres per year) per milking animal in each district. As information on milk procured by cooperatives is only available for 1997 and for some of the districts, a new dataset is used including only information for the years 1982, 1987 and 1992 but only for the districts with information on cooperatives. The independent variables are the same as before with the exception of the variable measuring the importance of cooperatives. The districts with information about cooperatives included in this database appear to have on average, higher number of hybrid cows per worker than the districts in the larger database used for the first regression.

Results of regressions including the cooperative variable are presented in Table 23 and show that the effect of cooperatives on the index of milking buffalos and hybrid cows per worker is positive but not significant. However, there is a positive and significant relationship between milk procured by cooperatives and the number of hybrid cows per worker, while the number of milking buffalos per worker and milk received by cooperatives is positive but not significant. This is evidence showing that cooperatives are important in those districts where the dairy sector is expanding through the use of improved technology in milk production using cows.

In sum, there is one consistent pattern explaining differences in the number of hybrid cows per worker across states: the contribution of the Green Revolution on development of the crop sector and its impact on infrastructure and income. According to our conceptual framework, these factors should act through increased demand for dairy products; lower transport and transaction costs and more developed feed and output markets. The impact of cooperatives is significant only when related to the growth in the number of hybrid cows per worker but not with the expansion of milking buffalos.

Income and Employment Generation in the Indian Dairy Sector

The dairy enterprise takes on great importance from the point of view of improving the socio-economic status of rural poor by reducing the longstanding problems of unemployment and under employment. Since distribution of livestock is more equitable than is land, growth in the livestock sector is deemed to be antipoverty and equity oriented. In 1999/2000 dairying, including processing and selling of product, engaged about 18 million persons in India, comprising 5.5 percent of the total workers (Table 24). Out of the total workforce engaged in dairying activities 92 percent are concentrated in rural areas. The distribution of workers among rural and urban areas differs considerably across states and the share of urban workers in dairying is surprisingly very high in Assam (43%) and West Bengal (24%). The share of persons engaged in urban areas in dairying is also higher than the national average in Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa and Rajasthan. Dairying seems to promote gender and social equity. Fifty eight

percent of the total workers engaged in the dairying sub-sector are women, although in urban areas it is only 37 percent. The participation of women in other activities including agriculture is low compared to that in animal husbandry particularly dairying. Further, the majority of dairy workers belong to socially and economically backward communities. Scheduled tribes (STs), scheduled castes (SCs) and other backward castes (OBCs) together constitute about 69 percent of the persons employed in dairy sector (Table 25). Further, about 92 percent of workers in the dairy industry are engaged in activities pertaining to farming and allied activities pertaining to primary production. This includes cattle rearing, goat rearing for milk production, breeding, ranching, grazing. The processing, including manufacturing of different dairy products like butter, ghee, milk powder, ice cream, kulfi, khoya, and cheese, engages only 1.2 percent of dairy workers in both the formal and traditional informal sectors. A little above 6 percent workers of dairy sub-sector is engaged in selling of milk and milk products, including both wholesaling as well as retailing. As expected, a higher proportion of workers in the dairy sector in rural areas are engaged in production related activities (95 %) and less than one percent in processing (0.8%). But in urban areas about 31 percent of the dairy workers are engaged in selling of milk and milk products.

Table 24. Employment in dairying in major states of India (in ,000 no.) and its distribution in rural and urban areas.

State	Rural	Urban	All	Rural (%)	Urban (%)
Andhra Pradesh	1986	158	2143	92.6	7.4
Assam	35	27	62	57.0	43.0
Bihar	664	64	727	91.3	8.7
Gujarat	1709	142	1851	92.3	7.7
Haryana	783	65	848	92.3	7.7
Himachal Pradesh	234	3	237	98.9	1.1
Jammu & Kashmir	28	5	34	83.7	16.3
Karnataka	470	76	546	86.1	13.9
Kerala	459	71	530	86.6	13.4
Madhya Pradesh	305	57	362	84.4	15.6
Maharashtra	842	169	1011	83.3	16.7
Orissa	178	30	208	85.6	14.4
Punjab	1559	84	1643	94.9	5.1
Rajasthan	2585	92	2677	96.6	3.4
Tamilnadu	844	135	979	86.3	13.7
Uttar Pradesh	3350	241	3592	93.3	6.7
West Bengal	182	58	240	75.8	24.2
India	16267	1520	17787	91.5	8.5

Source: Computed from unit level NSSO database (55th round)

Table 25. Percentage distribution of employment in dairying across social groups in major states of India (1999-00)

State	Scheduled Castes	Scheduled Tribes	Other Backward Castes	Others
Andhra Pradesh	11.6	20.8	51.1	16.5
Assam	8.9	9.2	26.6	55.3
Bihar	2.6	14.0	72.9	10.4
Gujarat	11.7	8.6	46.7	33.0
Haryana	0.2	23.4	29.5	46.8
Himachal Pradesh	1.5	17.4	5.2	75.9
Jammu & Kashmir	5.5	17.5	6.2	70.7
Karnataka	7.5	22.5	38.7	31.3
Kerala	0.7	10.5	48.7	40.1
Madhya Pradesh	13.7	17.9	57.7	10.8

Maharashtra	10.1	8.1	21.7	60.0
Orissa	19.1	10.5	48.2	22.3
Punjab	0.2	36.7	13.1	50.0
Rajasthan	23.5	13.5	35.6	27.3
Tamilnadu	1.5	23.5	72.4	2.6
Uttar Pradesh	1.9	25.4	43.2	29.6
West Bengal	-	31.6	14.5	53.9
India	8.2	19.6	40.9	31.2

Source: Computed from unit level NSSO database (55th round)

Employment generation in milk production

Farm level studies by Shiyani and Singh (1995) Sharma & Singh (1995), Singh (1997), Dixit (1999) have highlighted the importance and potential of dairy farming in generating regular employment and income. These studies found that the estimated employment generation by a milch bovine was in the range of 60-100 man days per annum depending upon region, categories of farm households and type of livestock species. Per household basis, the employment generated stretched between 150-300 man days per annum. It is widely accepted by various studies that the livestock sector provides much higher employment and regular income than any other agricultural and allied activities. Aggregate figures suggest that productivity of labour in dairying is about 2.5 times higher than in agriculture generally, based on aggregate output per worker in each sector. Annual return per unit of labour is about Rs 45,000 (about $1020) in dairying and about Rs 17,000 (about $390) in the agriculture sector as a whole. This is because of its labour intensive nature and the ability to generate employment from small land areas throughout the year and its role in redistribution of rural income. In addition the livestock sector has the potential to generate employment in the industries such as feed manufacturing, dairy equipment, animal skin & leather industries and service sectors in the form of veterinary hospitals & dispensaries, institutional and non-institutional finance, insurance, trade, etc.

An exercise was conducted to estimate and analyse the employment and income generated in the production at production level in rural and commercial dairy farms and also in marketing of milk through different informal channels. For this purpose the study analysed the employment generating potential of dairying in two of the most dairy developed states, Punjab and Haryana. Two districts each from Punjab and Haryana were selected and from each of these four districts two villages were randomly chosen. From each of these 8 clusters of farmers were selected on the basis of herd size representing three herd groups, Small (< 4 dairy animals, including both cattle and buffalo, and including calves and males), Medium (4-10), Large (> 10) and based on availability, another category in the form of commercial units with even larger herds were also included in the sample. Thus, in total a sample size of 260 farm units were covered in the study. The data on labour used in various operations and wage rate for the labours were collected apart from the information on general description of the bovine population and milk yield in the individual farm units. In the case of rural production units, direct employment included self, family and hired labour while indirect employment referred to labour involved in providing services to the milk producing farms.

Analysis revealed that the proportion of family labour to total labour used was highest in the large farms and the lowest in commercial units. The rural farms used mainly family labour which varied from 53 percent to 77 per cent of total, while the commercial units hired 60 per cent of their total labour requirements.

Table 26. Income and employment in milk production on average in Haryana and Punjab, under different scales of production.

		Small	Medium	Large	Commercial
Total milk production (L/farm/day)		4.5	19.6	60.6	140.8
Rate of employment generated (Jobs/1000L produced on daily basis)	Self employment	193.6	58.6	17.0	7.0
	Hired labour	36.5	38.2	8.4	10.6
	Total employment	230.1	96.8	25.4	17.6

Table 26 shows the employment and income implications of dairy production, combining the data from both Punjab and Haryana. As expected, the level of employment generated per unit milk production decreases dramatically as the herd size increases, For every 1000 litres of milk produced on a daily basis on small farms, some 230 jobs are created, mostly family labour (194). The rate of employment per unit declines to 17.6 jobs in the largest commercial operations, most of that in the form of hired labour (10.6). The data reveal (although not shown here) that less labour is used per unit milk production in Punjab than in Haryana, which is consistent with the perception of the higher level of development of Punjab dairy farms, which are likely to employ more labour-substituting strategies.

Employment generation in the milk market

Employment in milk marketing and processing was also estimated. The data were collected from rural milk producers and commercial farms and also informal milk processing and marketing units. Data related to both direct and indirect job opportunities created in the production, processing and marketing of milk were collected. The data on labour used in various operations and wage rate for the labours were collected. The data collection focused on the informal and locally processed channels, but includes retailers of packaged pasteurised milk.

These are the key channels for milk and dairy product flows, which reflect both traditional and formal markets, although not all are described in the employment data;

Producer – Consumer
Producer – Vendor - Consumer
Producer – Creamery / Halwai - Consumer
Producer – Vendor- Creamery / Halwai – Consumer
Producer – Vendor- Retailer - Consumer
Producer – Milk plants – Consumer
Producer – Ice Creamery – Consumer
Producer - Vendor – Milk Plants - Consumer
Producer – MPCC – Milk plant – Distributor – Retailer- Consumer

Among these, the direct Producer-Consumer channel, without any intermediaries, is still the predominant one in terms of market share, not only in the study sites, but also in India as a whole (Dairy India, 1997).

Table 27. Employment generation in informal milk markets in Punjab and Haryana, and national predictions.

	Employment rate (jobs per 1000L) assuming 8 working hrs/day	Proportion of marketed milk that is handled by type of agent (using entire Indian data)**	Estimated quantity of milk handled by type of agent nationally (Mt/day)	Estimated total number of jobs generated nationally	% of the total number of jobs
Milk Vendors (dudhias)	10.6 (.4)*	0.58	92,897	980,000	55
Halwais (sweet shops)	19.9 (.2)*	0.20	32,204	640,000	36
Creameries	13.4 (.9)*	0.01	991	13,000	1
Milk sachet sales (retailers)	5.4 (5.4)*	0.15	23,782	129,000	7
Ice-cream producers	25.9 (1.7)*	0.004	637	106,500	1
Total		0.94	150,511	1,778,500	100

*Indirect jobs in parenthesis. **Source for national market channel proportions: Dairy India, 1997

The levels of employment generated in informal milk markets are significant. Every 1000 L handled on a daily basis employs 10.6 milk vendors (dudhias), who each handle some 98 Kgs of milk per day, and collect milk from an average of 19 milk producers (Table 27). Nearly all these jobs created are in the form of self-employment. Due to value addition, some 20 jobs are created for the same quantity of milk daily in sweet shops, which employ 2-3 permanent workers, or more than 13 jobs in creameries. Creameries produce indigenous milk products such as *paneer, butter, ghee, cream, dahi*, etc., and collect milk from 13-14 vendors on average. Retail sales of packaged milk generate some 5 jobs per 1000L daily, as on average a retailer employs 12 persons who carry milk sachets in cycles/rickshaws and delivers them door to door. Also due to value addition, the employment generated in local ice cream production is high, estimated at some 26 jobs per 1000L of milk handled daily, of which 1.7 are in the form of service providers to maintain and repair equipment.

The data gathered on income from these activities was not reliable, so they are not presented. It is expected, however, that wages and returns to labour in these activities are comparable to other informal sector enterprises, and thus offer useful livelihoods.

Extrapolating these figures to the national level, which requires the large assumption that similar employment levels are found per unit milk across the country, allows some understanding of the level of employment generated through these sorts of small scale milk markets. In terms of proportions of milk flowing through each channel, national Indian data were used from Dairy India, 1997. They show that of the milk passing through the traditional market channels, besides that sold directly from producers to consumers, the milk vendors or dhudhias collectively handle the largest proportion of milk, 58%. They mainly procure directly from farmers and sell to other market intermediaries or final consumers. Sweetmakers also play an important role, handling some 20% of all the milk passing through the traditional channels.

These volumes translate into an estimated 1.8 million jobs, with milk vendors accounting for 55% of the total market jobs followed by halawis (36%). This excludes persons employed in the formal processing sub-sector but includes retailers of pasteurised milk (milk sachet sellers/retailers). This figure amounts to some 10% of the estimated total direct employment of 18 million in the dairy sector. This is comparable to but higher than the estimates based on the NSSO database, which indicate about 1.3 million jobs in the processing and marketing of milk and milk products at national level, particularly since the NSSO data do not include processing of milk at farm level, which is combined with milk production activities. The variation with the national estimates can be attributed to the fact that the NSSO database pertain to the 1999-00 and some changes in the composition of employment pattern is inevitable and heterogeneity of dairy development across different regions is not captured in the data collected from a specific region. In spite of the divergence, both the estimates reaffirm the significant opportunities that small scale and traditional milk market activities present

Thus it can be summarized that the informal and small scale dairy industry generates significant labour at each stage right from production through procurement, transport, processing and marketing of milk, much of which is available to low-skilled individuals who may have few other employment opportunities. Compared to processed markets, which employ many fewer labourers per unit milk, the traditional market is seen to be a comprised of labour intensive enterprise with an enormous potential for employment generation in the rural sector.

The significance of dairying in providing regular employment and income is indispensable, particularly to landless labourers and marginal and small farmers who still form the majority among milk producers in India. The fact that the rural farms create more employment opportunities than the commercial units, should enter in the formulation of policies for rural employment. Besides the employment generated at the production level in rural setting, dairy creates ample opportunities in the processing and marketing activities, with multiplier effects of dairying in creating jobs in other firms providing services.

Main Lessons from Indian Dairy Development

Having achieved the status of the largest milk producing nation in the world, India clearly offers a number of important lessons for dairy development, and the policies associated with it.

Effects of key factors and policies on dairy development trends

Multiplier effects of the Green Revolution - In general, development of the crop sector and the infrastructure related with this development during the period of the Green Revolution have played a key role in dairy development. The regional analysis shows clearly that the role of irrigation and fertilizer through increasing year around availability of fodder, and through broader innovation processes of farmer technology uptake, have been some of the main driving forces to dairy development in India.

Improved dairy animals – Improved (through selection) and cross-bred cattle, as well as dairy buffaloes, have played a key role in India's dairy development. This process has been accelerated by the mechanisation of agriculture and increased use of tractors, which has freed farmers to choose animals aimed solely at milk production, rather than dual milk-draught use. The success of cattle crossed with exotic dairy genes offers important lessons for similar approaches in tropical settings.

Demand and demographic change – Although the data were not able to show this clearly, it is apparent that growth in demand associated with income and population growth, as well as changes in rural demographics, have driven both overall scale of the dairy industry, but also productivity change through changes in land and labour availability.

Meeting traditional demand – Related to the growth in demand, was a shift by formal market processors to traditional Indian products such as *paneer, chhena, khoa, gulab jamun* , products formerly supplied almost entirely by the informal market. This created new market opportunities, and allowed the formal market to build on traditional demand patterns, rather than try to create demand

for Western style products. Some of the latter, however, such as sweetened yoghurt and ice cream, also helped create new markets.

Raw milk and traditional markets - These markets continue to dominate the dairy industry in terms of market share, although they are gradually giving way to formally processed product markets. By virtue simply of their colossal scale, they have clearly played a role in being the primary mechanism for linking growing demand among consumers with increased production coming from producers. A key policy ingredient in this role was the *laissez faire* approach by regulators and policy-makers generally towards small scale informal market activity. That policy stance, although perhaps not stated but nevertheless implemented and observed, has allowed the relatively efficient operation of a highly atomized, organized and mostly competitive milk and dairy product chain.

Milk and Milk Products Order (MMPO) – Data were not available to assess the contribution of this set of regulations, which gave preference for new dairy processing investment to cooperatives vs. the private sector, among other things. Although it may have contributed to sustaining cooperatives in areas where they might otherwise not have been competitive, the growth in the private dairy sector in last few years suggests that the restrictive aspects of the MMPO may have restrained private sector investment, and dairy development generally. However, the amended MMPO does not have any restrictions on setting up the new capacity and did away with the concept of milk shed to target and regulate investment, and emphasizes only on sanitary conditions, hygiene, quality and food safety.

Cooperative development. Although the Operation Flood and the role of dairy cooperatives is always mentioned as a key factor in the growth of the dairy sector in India, the empirical evidence suggests that the role of cooperatives in growth was not as direct as generally stated. Cooperatives still account for a small proportion of dairy market share, and there is little evidence to show that development of milk markets through cooperatives has driven growth in dairy: some of the states with the strongest growth, such as Punjab, have had little activity by dairy cooperatives. However, the evidence does suggest that dairy cooperatives have had impact on the supply side, in fostering the introduction of new technology, particularly improved dairy cattle. The role of cooperatives may thus have been more in terms of supporting technology development and uptake.

Investment of donor aid – Related to cooperative development, was the role of aid in the form of imported surplus dairy products, whose sale was then reinvested in dairy development activities generally, and particularly in cooperative development. This allowed the establishment of cooperative sector, and also contributed to the development of infrastructure for improved breeding services. Key to the success of that aid, however, was the integrity and efficiency of use of the investments.

Effects of trends, key factors and policies on the poor

Employment. The dairy industry has been shown to provide an overwhelming level of employment to rural and urban poor. Between 1.3 to 1.8 million people nationally are estimated to be employed in the raw milk and traditional product market that dominates the sector. In markets, small scale entrepreneurs have successfully entered into a diversity of products, including ice cream, expanding opportunities by tapping into shifting tastes and income trends. At the production level, some 18 million people nationally may be directly employed in dairy production, either are farmers or as hired labourers on dairy farms. There is no question that growth in the dairy subsector, and consequent growth in smallholder production and marketing, has played an important role in poverty alleviation, and in income for women. Many of those hired on dairy farms are likely to be among the poorest. Also, considering that a significant proportion of milk production comes from landless and socially marginalized producers, dairy provides significant opportunities for those groups as well, for whom alternatives may be very few. As has been demonstrated in studies elsewhere (Moll, 2005), livestock assets used in dairy production may provide a key avenue for capital accumulation, financing other productive activities, and insurance for these resource-poor households.

Trends in Productivity and Scale. The results both from the farm survey and the wider analysis of trends show that India has experienced significant growth in productivity at the farm level. That productivity growth is also reflected in scale of production, in that the amount of labour used per animal decreases as the herd size increases. There is thus lower unit employment with dairy development. However, higher productivity is likely to be associated with higher returns to labour and wages to hired labour. If increase in scale of production and productivity is a result of rising opportunity costs of labour due to economic development, as seems to be the case in Punjab for example then, as described in the Conceptual Framework, these trends can be seen as positive and as associated with increased commercialisation and evolution of small-scale production, and improved producer livelihoods. At the same time however, the continued dominance of smallholder producers suggests that smallholders can still compete strongly. This is further supported by recent work by Sharma et al (2003) that shows that profits per unit milk are highest on Indian farms producing less than 10 L per day, and that profit efficiency on small scale farms is also greater than that on larger farms. The pattern thus has multiple facets, with gradual increase in scale and productivity particularly in areas with general agricultural commercialization such as Punjab, accompanied by generally strong competitiveness of small scale and even landless producers across India, pointing

towards continued dominance of small scale production even while larger producer gradually gain greater share in certain areas.

Crop-livestock market integration. Successful and sophisticated fodder markets in India and also exchange mechanisms for dung mean that landless producers can enter into viable dairy production. These institutions are critical for assisting the participation of the poorest households, in that landless producers can exchange dung for crop residues and fodder with landed crop producers. Associated with this, is the fact that small scale producers are shown to create the lowest levels of negative environmental externalities caused by animal wastes (Sharma et al, 2003).

Market linkages. Several factors have worked to ensure that smallholder dairy producers can retain participation in gradually changing market. Key among these of course has been dairy cooperatives in a number of States, to which tens of millions of smallholder rural milk producers belong and rely on to sell their milk. Another increasingly important avenue for reliable market linkages that provide scope for increased productivity and scale are contract farming arrangements with private dairy processors, such as those with Nestle in Punjab. It appears that to some extent, smallholders can participate in these. However, the available evidence suggests that the informal/traditional market has been the primary avenue for linking to output markets for the large majority of producers, and particularly the smallest and most marginalised. This has implications for the policy strategies below.

Policy opportunities and entry points, strategies and resources

The evidence available points to several avenues and strategies for policy interventions to support dairy development, and it's role in rural livelihoods and employment.

Support mechanisms for smallholder participation in markets – contract farming. As discussed above, in some cases where smallholders are commercialising, contract farming with private processors offers assured and remunerative markets. Further support to such efforts should be encouraged. However, policy makers may need to evaluate the conditions and barriers to small farmer entry into such contracts, and provide incentives for processors to specifically include small producers in these schemes.

Address raw milk and traditional markets constructively. Given the continued dominance of these markets for the foreseeable future, it would be prudent to address these markets in a constructive manner. The general *laissez faire* approach historically followed should allow these markets to function competitively, but increased attention to quality by the growing middle class may require policy makers to pay more attention to those issues. One means of doing that is to begin to introduce training and certification programs for small scale milk and dairy product traders and processors, as has been done in Kenya under the DFID Smallholder Dairy Project. This would allow some bridging of the quality gap at the same time allowing these markets to function, and play their vital role in serving poor farmers and consumers, and in generating employment.

Target traditional demand. The Indian case is an excellent example of how to target demand for traditional products to help grow the formal, processed market. The last 10 to 15 years have seen a large growth in supply of traditionally processed products such as *paneer* from formal processors, who previously and partly due to imported processing methods, had been promoting many western products such as hard cheeses, etc. Additional support and attention can be given to this process, which allows strong demand for traditional products to be better met, and will allow .

Support continued animal breed improvement. India also provides a strong case for continued investment in improved breeds of cattle and buffalo. With the proportion of cross-bred dairy cattle in the population at over 70% in some States (including crosses between indigenous breeds), it is clear that exotic dairy genes can play an important role in even semi-arid, high temperature settings. The regional analysis shows that improved animals have been critical to dairy productivity and development. Further public support to this process, as well as through cooperatives, is central to the continued progress of the dairy industry.

Pursue trade opportunities. Studies have shown that Indian dairy production is competitive in comparison with other countries (Sharma et al, 2003). While the domestic market may provide the largest engine for growth, support should be given to identifying and tapping into export markets, possibly related to demand for traditional products from Indian communities globally.

Synthesis of Regional and Country Results: Defining an Agenda for Pro-Poor Dairy Policy and Development

In this final section, the lessons from the regional and country case studies are synthesized, and where appropriate, the implications of those lessons for policy and planning strategies are elucidated.

Synthesis of key lessons for dairy development and policy

1. **Demand side change**. The analyses highlight the importance of growth in consumption and as a consequence, in demand, brought about either through growth in GDP/capita or exports, or through increased urbanization. This has been the case particularly in India and South Asia in general, where these trends have been stronger than in East Africa. In East Africa, demand side factors were shown to play a key role in the three countries with the fastest milk productivity growth: Sudan, Kenya and Uganda. Conversely, in the poorer countries in East Africa where for long periods, per capita incomes had hardly made improvement, the dairy industry also barely grew In some cases, where average consumption per capita has not grown strongly, urbanization has contributed to change. While urbanization is one source of increased demand growth for milk, the case studies also reveal the importance and the magnitude of rural demand (for raw milk and traditional dairy products), even of low-income household, such that stimulating this segment of demand through general agricultural and rural income growth and development will have strong potentials in furthering the development of the dairy sector.

This leads to several implications:

- Supply side interventions can in some cases be over-credited with bringing about growth. The Indian milk revolution, for example, may be largely a result of demand side forces, although the technical and agricultural sector factors discussed below played a key role as well. Unless these facts are understood, there may be over-emphasis on supply-side interventions that have not been demonstrated to bring about development in some cases.
- Clear understanding of potential market trends and opportunities is needed for policy and planning in the dairy sub-sector. Because demand is highly conditioned by local perceptions and traditions regarding dairy consumption, this understanding should be pragmatic and based on local realities, not based on assumed duplication of the trends observed elsewhere. This requires a deeper understanding be made on the characteristics and nuances of these demand patterns particularly for raw milk and traditional milk products, particularly by lower income households and not just by higher income classes. More on this issue below, related to informal markets.
- Where poor people play a large role in the consumption of dairy products, interventions to support the provision of low-cost products are likely to simulate dairy development. This is particularly relevant to the generally officially favoured formal sector, which continues to incur high costs of packaging and processing, and so struggles to compete against lower cost traditional products. Through exploring such alternatives as unpackaged bulk liquid sales and low-cost packaging, the formal sector must reduce costs of products if it is to grow significantly. Supporting demand by resource-poor consumers also implies more conducive policies towards low-cost traditional products.
- Interventions to facilitate better, more efficient supply-demand linkages are also likely to have positive impact.

Supply side change.

Farm-level technical change.

Improved dairy animals. A consistent and overwhelming outcome of the analysis, both at the regional and country case levels is that nearly all strong dairy development growth scenarios are associated with *technical change in terms of yield per animal*. This occurred in the form of improved dairy cattle, generally cross-bred with exotic *Bos taurus* genes but not exclusively, and improved dairy buffaloes. Genetic improvement has obviously had dramatic impact on development and growth.

- Clearly, use of exotic cattle genes is a rapid and potentially sustainable path to higher productivity, even among small and resource poor farmers. Of course this is true particularly in a temperate climate such as found in highland Kenya, Ethiopia, and Sri Lanka, but the significant and growing proportion of cross-bred dairy cattle in India and in low-land Sri Lanka demonstrates overwhelmingly that it is also a viable solution even in warm climates, both semi-arid and humid.
- The warnings heard sometimes against promoting cross-bred cattle in high temperature, high disease risk environments do not always appear to be well-founded, at least from the perspective of farm productivity and economic viability (an animal welfare perspective might

suggest otherwise). Although there are many examples of catastrophic failures in introducing exotic cattle to the tropics (e.g. air-freighting grade cows from temperate, disease-free zones), it is equally clear that it is possible to develop and sustain cross-bred dairy production systems, given appropriate breeding strategies and disease control measures, and that these systems have often played a key role in dairy development.

- National and local breeding strategies need to address these realities, both from the perspective that demand for and suitability of cross-bred cattle may be greater than assumed from a pure animal science point of view, and that sustaining improved cattle in high-risk settings may require adapted systems for delivering the appropriate animal genetics. In milk-deficit coastal Kenya, for example, only pure breed exotic or local cattle semen is available – systems do not exist to produce and supply the cross-bred semen that experienced dairy producers demand.
- While buffaloes play a key role in semi-arid India and Pakistan, their potential in the humid tropics in S Asia may not be fully exploited. This may be the case in Sri Lanka and Bangladesh, although in these cases, buffalos have traditionally played a different role, providing draught power particularly for paddy cultivation.

Fodder technologies**.** Although it is difficult to capture the role of fodder technology in the aggregate analyses in this study due mainly to lack of data on fodder availability, the Kenya case at least was able to demonstrate that planted fodder technology played a key role in the growth in dairy productivity in that country.

- It is likely that improved fodder technologies have or could play a similar role in other countries or settings, and should be promoted where appropriate.
- Research has shown that the "appropriateness" of intensive fodder production is much more likely to depend on availability of cheap labour, scarcity of land, and good access to milk markets, than it is on agro-climatic setting (Baltenweck et al, 2003). Where labour is scarce, evidence shows that intensive fodder cultivation practices and even feeding of crop residues to cattle, unless mechanised, are unlikely to be taken up. Interventions to promote those should pay very close attention to labour opportunity costs.
- Where relative land and labour values constrain uptake of specialized fodder technologies, an avenue for increased productivity may be through improved breed of "food-fodder" crop varieties that have been bred to increase the fodder quality and digestibility of the straws and stovers they produce. In that manner, existing crop residues have higher value for dairy production.

***Agricultural sector growth*.**
In some regions and countries, general agricultural sector growth and transformation was shown to play a role in dairy development. India and Pakistan were able to link the transformation in agriculture originating in the Green Revolution to successfully expand production and output per worker which is reflected in the contribution of input markets and technology to growth in milk production per worker. That Revolution was based on various combinations of the HYV seed-fertilizer-irrigation-mechanization technology packages. These packages not only increased supply of crop residues and grains for feeding, but the wider services associated with their delivery and with the grain market development improved rural infrastructure and services generally associated with agricultural development, and also increased the demand for animal manure for crop soil amendments. A key factor was the increased use of tractors associated with agricultural sector growth, thus reducing the need for farmers to retain cattle for traction, and allowing a shift in bovine production towards milk. The link with the agricultural sector is not as evident in some other South Asian countries or in East Africa, although a reduction in the proportion of agricultural workers, is linked to increased dairy development. Given the very low use of fertilizer and HYV varieties currently on smallholder farms in East Africa, except in the most intensive highland settings, replicating the GR there is currently unlikely. Productivity change in that case, may continue to rely on fodder technology, given the low opportunity costs of labor.

Traditional milk and dairy product markets. One of the key findings of the study is that traditional/informal milk markets have played a key role in dairy development in both regions and in most countries. In countries with the strongest growth, such as Pakistan, India, Sudan, and Uganda, traditional, small scale markets control over 80% of marketed milk. In Pakistan the figure is well over 90%. Additionally, there is no evidence that this basic structure will change significantly in the next few decades. In India, in spite of heavy investment in formal cooperative structures, the formal sector has grown by only a few percent of market share in the last 30 years. This simply mirrors the reality in many developing countries, particularly those where milk is a traditional product. For example, even in relatively developed countries such as Brazil[10], traditional markets still control some 50% or more of market share (Staal, 2003). These facts,

[10] While changes in private milk quality standards in Brazil have recently forced some producers out of the formally processed milk market, it remains unclear whether these small producers have discontinued milk production or have instead moved into the informal sector.

which are often overlooked because traditional markets are generally not reflected in national dairy industry statistics, pose several important implications for dairy policy and development.

- All the evidence suggests that the traditional market dominance is not a result of lack of investment in formal market channels, or of non-enforcement of national milk standards, but rather that they are the result of continued strong *demand* for the products and services that they offer. In short, regardless of policy interventions and enforcement of regulations, these markets will continue to play a strong role, even if they have to operate outside of the regulatory environment. As a consequence, in many cases, investment in formal dairy processing facilities both in the private and public sectors, have simply failed, leading to underutilized capacity surviving on subsidies, or abandoned milk processing plants and cooling facilities.
- While much of the demand for traditional market products comes from resource-poor consumers, in some cases there is strong demand for such products by high income consumers (SDP, 2004a). Thus, general growth in disposable income may not necessarily reduce demand significantly.
- The analysis in this study does not support the view that formal market structures are required to stimulate dairy development. One of the countries in this study with the strongest growth, Pakistan, displays a negligible formal market share. In East Africa, the analysis shows a clear *negative association* between formal market share and dairy development as measured. This is likely to be because formal market share in that region was less a result of market forces but rather due to public investment decisions, and because poorly managed formal market institutions provided a much less effective link between farmers and consumers than have the traditional, informal market.
- Traditional, informal markets have thus clearly provided an effective, functional link between farmers and consumers, responding to consumer demand, and should not be regarded as market failures. Moreover, such markets are generally those most often serving the needs of small farmers and resource poor consumers. The analysis has also demonstrated the large and positive employment implications of such markets.
- Public policy-makers should thus engage constructively with traditional markets rather than oppose them directly, particularly as demand for food safety may grow with increases in disposable income. Policies that allow the continued functioning of such markets, but which support increased quality and food safety in those markets, are likely to be pro-poor in nature. Policies that simply oppose and attempt to police such markets, are likely to impact negatively on both small farmers, consumers and of course small scale market agents.

Dairy cooperative development. Mixed messages emerge from the analysis of the two countries where cooperatives have played a significant role in dairy development: Kenya and India. Although the Kenya data available were not able to demonstrate this empirically, there is adequate evidence to suggest that particularly up until the end of the 1980s, dairy cooperatives played a significant role in fostering dairy development, primarily in providing a stable market environment and delivering farmer services. At the same time, however, as mentioned above, formal markets of which cooperatives are part, were negatively associated with dairy development. In India, where some data were available, there was no evidence that cooperative development was associated locally with dairy development as measured. However, they were found to be associated with genetic improvement in dairy animals, and so presumably with higher milk productivity.

- Dairy cooperatives may play an important role in providing a base for farmer service delivery and for generally stable agricultural knowledge systems for uptake of improved technology, and increased management skills among farmers.
- There is no empirical evidence that dairy cooperatives are more effective than other market channels in linking poor farmers to output markets. Pakistan illustrates very dramatically that strong market growth can occur in the absence of dairy cooperatives.
- The mixed experience in both Kenya and India over the decades and between different localities suggests that positive impacts from dairy cooperative development is heavily dependent on good coop management, on honest and effective investment of resources, and on accountability to the interests of the farmer members. The substantial financial resources and investment that some large cooperatives control provide an attractive target for corruption. These all require, again as demonstrated in both countries, that *political and governmental influence* in cooperatives in minimized.
- Further, dairy cooperatives often cannot easily tap into the strong demand for traditional products and raw milk, and generally remain tied to demand for formally processed products. While traditional demand remains the driving force, dairy cooperatives face the same growth impediments that does the formal private sector.
- Investment in dairy cooperative development can be effective and pro-poor, if well-managed and placed outside strong political forces, and if it is linked to strong demand. However, because that is difficult to achieve in what are often quasi-parastatal organisations, dairy cooperative development *should not be the primary focus* of dairy development efforts, but rather should be part of a mix of market channels including formal private sector and small scale traditional. When market forces shift more strongly towards formally processed products, and when local governance mechanisms improve, dairy cooperatives in these

regions could play a more important role, as they do in North America and many other industrialized countries.
- In the interim, other less formal forms of farmer groups, such as self-help groups, could play important roles in some local cases. In Kenya, they have played an increasing role as cooperative shares declined in the 1990s (Morton et al, 1999). Because these are smaller and control fewer resources, they are less likely to be targeted by politically powerful interests, and are also better adapted to linking directly to the traditional market.
- Other formalized forms of market linkages may also be explored, as discussed below.

Smallholder competitiveness. In all of the country cases analysed, there was evidence that larger dairy farms and producers are more efficient. In the four country cases, for example, the amount of labour used per animal and per unit milk decreases as the herd size increases. However, there is also ample evidence to suggest that smallholder dairy producers are competitive generally, and are likely to endure for some time to come, particularly where the opportunity costs of family labour and wages remain low. The most compelling evidence towards this is the continued dominance of role of smallholders in all the countries studied, even in the context in some cases of steady economic growth. Outside of this study, other research has shown that in terms of unit milk profitability, smallholder dairy producers nearly match or exceed larger producers in India and Kenya, and in other countries in Asia and Latin America as well (Delgado et al, 2003, Sharma et al, 2003, Omiti et al, 2005). Because of the demonstrated powerful employment benefits of smallholder dairy production in this study, this competitiveness should provide a basis for continued public support for the smallholder dairy sector. Further, dairy as an enterprise is an available option for landless and socially marginalized groups such as seen in India, and research in Kenya has also demonstrated that female-headed households are just as able to enter into dairy production as male-headed households (Staal et al, 2002). Further, research has also demonstrated that because of the value of cattle as insurance and finance mechanisms, smallholder producers are able to capture non-market benefits from the dairy enterprise that larger producers are unlikely to be able to capture (Moll, 2005). These non-market benefits mean that even where milk markets are providing poor production incentives, smallholders are likely to continue to produce and achieve some household objectives.
- Policy-makers and development investors should resist the often-heard assumption that the role of smallholders is ending, suggesting that efforts should now be made to support larger scale, "more efficient" milk production to meet growing consumer demand. Instead, that growing demand should be used as a mechanism to help continue and sustain smallholder dairy enterprises.
- Smallholders may in some cases face increased barriers to participating in changing markets through higher demand for quality and quantity, and so alternative options to help them overcome those should be explored and promoted where appropriate. Contract farming may be one example, allowing smallholder competitiveness at the production level to be linked to scale-economic and lower-risk mechanisms for milk collection and distribution.

Public investment. Due to data limitations, the analysis was not able to show a link between agricultural R&D and growth in dairy development, mainly because no measures of R&D investment towards dairy specifically were available. It is possible, nevertheless, that R&D is generally not well linked in some cases to small farmer needs, reducing its effectiveness. In much the same way, no adequate analysis could be conducted with regard to credit. The credit analysis available shows mixed effects and is not related to growth in East Africa, but is negatively associated with dairy development in South Asia, which may simply be a function of the way in which credit is measured in this case, as the majority of players in dairy development in these regions may have no access to credit as it is being measured here. Nevertheless, R&D in adapted technologies to improve dairy productivity is very likely to have positive impact, particularly when targeted to the needs of the predominant smallholder producers. Other research gives mixed results in terms of the importance of credit in dairy systems, at least at the small farmer level. While Delgado et al (2003) underline its importance in contributing to profitable milk production in India, Omiti et al (2005) and Baltenweck (2000) suggest that access to credit is not a significant barrier to entry into or profitability of dairy production in Kenya. In spite of the lack of strong empirical evidence in this analysis, it is reasonable to assume that investment in dairy R&D and in provision of appropriate credit to smallholder producers will grow in importance, particularly as producers shift towards greater commercial orientation, increasing their demand for improved technologies and for investment.

Trade policy. Imports and exports, as well as macro policy and level of openness of the economy, show very mixed results, and cannot apparently be demonstrated to consistently to play a role in the pace of development. In East Africa, dairy development is negatively associated with a more open economy, but that may be related to more general growth factors. In that region, milk export levels are not associated with dairy development. In South Asia, somewhat the reverse is suggested –no association with the level of openness of the economy. In both regions, however, export levels are very small in proportion to domestic production. Imports are also generally very small in proportion to domestic production, except in some countries such as Bangladesh, Sri Lanka and Malawi.
- Exports, as demonstrated in South Asia, may play a role in dairy development, and export opportunities might increase if for example EU export subsidies are curtailed as is expected. However, quality requirements of export markets are stiff, and the levels of investment and expertise required to meet those will limit the opportunities.

- Countries that do not have a strong tradition of milk production and consumption, such as those mentioned above, are particularly susceptible to import competition. This is likely to be a function of demand issues, rather than lack of domestic supply. Where there are strong dairy traditions, most demand is for raw milk and traditional products, which imports cannot easily substitute for, if at all. Supporting the development of traditional markets thus takes on the added feature of helping buffer domestic producers from imports.
- Even though trade in dairy products is generally a very small proportion of domestic production, policy makers, industry and researchers tend to give a disproportionate amount of attention to trade issues, most likely because of the issues of national pride and self-sufficiency associated with them. However, there is not much evidence that trade issues are of major importance for the welfare of the large majority or producers, market agents, or even consumers. Again, this is largely due to strong demand for domestic products in most of the countries in both regions. As a basic measure, the quantity of milk handled in the Indian traditional/informal market alone, is *greater annually than total world trade in all dairy products*, measured in liquid milk equivalents (Staal, 2003).[11] The projections under the Livestock Revolution work by Delgado et al (1999, 2001) show very clearly that the demand growth and opportunities in milk is going to happen domestically rather than across borders.
- Policy-makers and planners would be well advised to focus their attention on the much larger and more dynamic domestic markets, rather than the smaller and less welcoming international markets.

An Agenda for Pro-Poor Dairy Policy and Development

The lessons learned from this analysis, as well as those gleaned from the other research cited, present some elements of what might be termed an "Agenda for Pro-Poor Dairy Policy and Development". This model aims to raise the welfare of farmers and small scale market agents, to meet the needs of poor consumers, and to sustain the natural resource base in the context of continued intensification of mixed production systems. Given these multiple facets, the objectives of pro-poor dairy development could be summarized as follows.

Objectives of pro-poor dairy development

1. Employment creation in rural and periurban areas both on farm and along market distribution and value chains.
2. Reliable income generation and asset accumulation for resource-poor farmers.
3. The provision of low-cost and safe dairy products to resource-poor consumers.
4. Improved natural resource management and sustained farming systems through dairy cattle-mediated nutrient cycling.
5. Improved child nutrition and cognitive development in resource-poor households.

Elements of a model for pro-poor dairy development

Such a model would simply incorporate the lessons and recommendations outlined above, and so would include the following main elements:

1. Build on traditional dairy product consumption habits and preferences, at the same time as promoting demand for new products.
2. Support development and evolution of traditional domestic markets for milk and dairy products, at the same time as promoting appropriate formal market development.
3. Emphasize and support the role of smallholder dairy production as primary means of rural income generation and sustaining the intensification of mixed crop-livestock systems.
    a. Appropriate, improved animals and the systems required to deliver those to smallholders
    b. Fodder technologies and exchange mechanisms for fodder and crop residues
    c. Institutional mechanisms for enhancing smallholder participation in growing local markets – cooperatives but also contract farming, other forms of farmer groups.

Building on traditional consumption habits**.** The concept of value-addition is often used to promote processing of milk into a variety of dairy products. However, the choice of products promoted is often dictated by Western-style dairy processing practices. This typically ignores the fact that in many countries, consumer preferences and habits favour traditional products – Western-style products are

[11] Using FAO production and trade figures from 2002, and estimates based on India milk market shares in this study, the traditional market in India handled just over 70 million MTs of liquid milk equivalent (LME). In contrast, total global dairy product trade was just under 70 million MTs of LME.

often not regarded as good value for cost in the eyes of poor consumers. Markets for traditional products are typically the largest in any developing country, and so offer good opportunities. Building on traditional habits also requires focusing first on products known to consumers, and adapting them for better "quality", safety, and value addition, while maintaining low retail cost as a primary consideration, given the majority of resource-poor consumers. At the same time, opportunities can be exploited for promotion of new products, which may offer better possibilities for fast growth within small market niches.

Support development and evolution of traditional domestic markets. Traditional markets continue to dominate many development countries for the reasons above – strong traditional consumption habits, which are typically not well served by Western-style dairy products, and which put a high priority on low cost products. As demonstrated, these markets, typically highly labour-intensive and based on many small market agents, are known to generate greater levels of employment than Western-style processed dairy product markets per unit of milk handled. However, indigenous markets face major constraints due to lack of established guidelines and procedures, lack of appropriate low-cost equipment, and lack of relevant and supporting policies. The quality of products supplied through indigenous markets may be highly variable, and may sometimes pose public health threats. Such threats, however, are often exaggerated in the context of consumer habits of home processing before consumption. Nevertheless, variable quality impedes consumer confidence, raises transactions costs for consumers, and hinders market development. Development and evolution of traditional markets requires integrated interventions to address the above constraints, including policies, guidelines and training for small-scale market agents. An example of this is the "training and certification" for small scale milk agents developed by SDP in Kenya, which provides a mechanism for raw milk sales to be allowed under basic standards of hygiene. However, this does not preclude the simultaneous development of formal Western-style processed product markets, which may offer greater long-term reliable market opportunities, including export markets. The focus should however, remain on domestic markets rather than the higher-profile international trade.

Sustaining farming system intensification through smallholder dairy production. Many mixed crop-livestock systems in poor countries are characterized by small and shrinking land holdings, and by poor soil fertility. Poor soil fertility generally remains the largest single technical constraint to agriculture in many countries. Evidence from highland areas of East Africa, as well as South Asia, shows clearly that small scale dairy production can play an important role in improving soil fertility and natural resource management. Dairy cattle not only serve to improve cycling of nutrients on farm by converting crop residues into manure, but also serve as a channel for importing nutrients from off-farm through concentrate feeds and fodder brought from off-farm. Smallholder producers are more likely to operate in this integrated manner than large-scale producers, who are typically more specialized in dairy production. Deliberate emphasis on smallholder production, and on production strategies that integrate crops, livestock and resources management, serves to promote both rural income generation and sustainable intensification.

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