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Dairy development in Ethiopia

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1 Introduction

Over the last decade following the political changes in 1991, the dairy sector in Ethiopia has shown considerable progress. Total milk production grew at an estimated rate of 3% compared to 1.8% during the period from 1975–90, thus ending the extended declining trend in per capita milk production in the country. The progress achieved is mainly due to technological intervention, policy reforms and increases in demand for dairy products due to population growth and urbanisation. The dairy sector in Ethiopia is expected to continue growing over the next one to two decades given the large potential for dairy de- velopment in the country, the expected growth in income, increased urbanisation, and improved policy environment. The shift towards a market economy is creating a huge opportunity for private investment in urban and peri-urban dairying. However, the main source of growth is expected to be the growth in demand for dairy products.

Ethiopia holds a large potential for dairy development. The country currently manages the second largest livestock population in Africa, estimated at 29 million cattle, 24 million sheep and goats, 18 million camels, 1 million equines and 53 million poultry. In ad- dition, the country enjoys diverse topographic and climatic conditions. These consist of a high central plateau ranging from 1800 to 3000 metres above sea level (masl), a rift valley that divides the country from north to south with altitudes ranging from 1000 to 1800 masl, and lowland plain areas of less than 1000 masl in altitude. Depending on the altitude, temperature ranges from less than 10°C in alpine areas to 35°C and higher in the lowlands. Moreover, rainfall in most of the country is adequate for crop and pasture production (Alemayehu 1987). The favourable climate throughout the country supports the use of improved, high-yielding animal breeds and offers a relatively disease-free en- vironment for livestock development. The success realised in neighbouring Kenya is also expected in Ethiopia, given the high potential for dairy development, the on-going policy reforms and technological interventions and the very similar production environment.

Given the considerable potential for smallholder income and employment generation from high-value dairy products (Staal 2002), the development of the dairy sector in Ethiopia can contribute significantly to poverty alleviation and nutrition in the country. Ethiopia, with its over 65 million inhabitants and an average annual per capita income of less than US$ 100, is among the poorest countries in sub-Saharan Africa (SSA). Levels of malnutrition are consequently high. The Food and Agriculture Organization of the United Nations (FAO) estimates that about 51% of the population is undernourished and over two million people are considered chronically food-insecure (FAO 2001). Com- pared to other countries in Africa, Ethiopians consume lesser amount of dairy products. Per capita consumption of milk in Ethiopia is as low as 17 kg while the average figure for Africa is 26 kg (Alemu et al. 1998). Besides providing income-earning opportunities for the poor, dairy development, especially at the smallholder sector level, can improve the nutritional status of Ethiopian children by making available milk for consumption and increasing household income.

The excess demand for dairy products in the country is expected to induce rapid growth in the dairy sector. Factors contributing to this excess demand include, rapid population growth (estimated at 3% annually), increased urbanisation and expected growth in incomes. With the shift towards a market economy and liberalisation policies, private entrepreneurs are expected to respond to the increased demand through in- creased investment in dairying and milk processing. While the response of the private sector to the increased demand for dairy products is expected to be significant, the small- scale household farms in the highlands hold most of the potential for dairy develop- ment.

This paper assesses the development of the dairy sector in Ethiopia over the past 50 years. In particular, it presents an overview of the dairy sector in Ethiopia. It also identifies key phases in the development of the dairy sector in Ethiopia and examines the trends in production and consumption, policy changes and development emphasis during each phase. Apart from these, the paper provides evidence on the potential impact of improved dairy cattle, examines the factors that increase smallholder participation in market-oriented dairying and identifies key policy and technology issues to be considered in the design of appropriate policy and development strategies. The paper also draws together evidence from neighbouring countries in order to assist in drawing conclusions for dairy development strategies in Ethiopia.

2 Overview of the dairy sector in Ethiopia

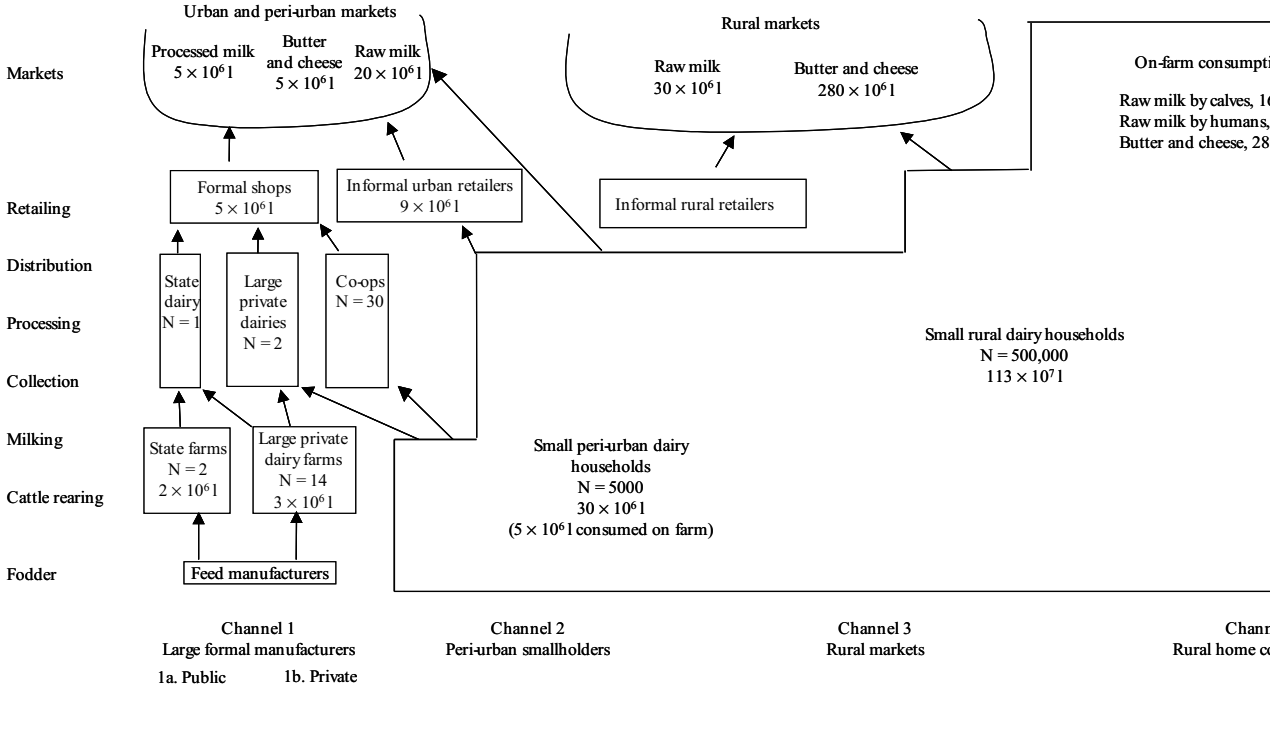
2.1 Production systems

Livestock are raised in all of the farming systems of Ethiopia by pastoralists, agro-pastoralists, and crop–livestock farmers. According to Tsehay (2002), milk production systems can be broadly categorised into urban, peri-urban and rural milk production systems, based on their location (Table 1). Both the urban and peri-urban systems are located near Addis Ababa and the regional towns and take advantage of the urban markets. The urban milk system consists of 5167 small, medium and large dairy farms producing about 35 million litres of milk annually. Of the total urban milk production, 73% is sold, 10% is left for household consumption, 9.4% goes to calves and 7.6% is processed into butter and ayib (cottage cheese). In terms of marketing, 71% of the producers sell milk directly to consumers (Tsehay 2002). The peri-urban milk system includes small- holder and commercial dairy farmers near Addis Ababa and other regional towns. This sector controls most of the country's improved dairy stock. The rural dairy system is part of the subsistence farming system and includes pastoralist, agropastoralist and mixed crop–livestock producers, mainly in the highland areas. The system is not market-oriented and most of the milk produced in it is retained for home consumption (Figure 1). The level of milk surplus is determined by the demand for milk of the household and its neighbours, the potential to produce milk in terms of herd size, production season and access to a nearby market. The surplus is mainly processed using traditional technologies and milk products such as butter, ghee, ayib and sour milk are usually marketed through the informal market after the households satisfy their needs (Tsehay 2002).

Table 1. Structure of demand for milk products in Ethiopia, 2000.

	Households			
Milk products	Rural (%)	Peri-urban (%)	Urban (%)	Total (%)
Raw milk consumed by calves	32	13	9	32
Raw milk consumed by humans				
Farm households	15	8	10	15
Marketed	2	59	61	4
Butter	41	20	8	40
Cheese	9			9
Pasteurised milk	1	0	12	1
Total milk equivalent volume (%)	100	100	100	100
Litres ($\times 10^6$)	1115	15	20	1135

Sources: Belachew et al. (1994); Alemu et al. (2000); Getachew and Gashaw (2001); Tsehay (2002).



N = Number of producers

ure 1. Dairy marketing channels in Ethiopia, 2002.

The dairy sector in Ethiopia can also be categorised based on market orientation, scale and production intensity and classified into three major production systems: traditional smallholders, privatised state farms and urban and peri-urban systems (Alemu et al. 2000). The traditional smallholder system, roughly corresponding to the rural milk production system described above, produces 97% of the total national milk production and 75% of the commercial milk production. This sector is largely dependent on indigen- ous breeds of low-productivity native zebu cattle, which produce about 400–680 kg of milk/cow per lactation. The state dairy farms, now being privatised or in the process of privatisation, use grade animals (those with more than 87.5% exotic blood) and are con- centrated at a distance of 100 km around Addis Ababa. The urban and peri-urban milk production system, the third production system, includes small and large private farms in urban and peri-urban areas concentrated in the central highland plateaus (Getachew and Gashaw 2001). This sector is commercial and mainly based on the use of grade and crossbred animals that have the potential to produce 1120–2500 litres over a 279-day lactation. This production system is now expanding in the highlands among mixed crop–livestock farmers, such as those found in Selale and Holetta areas and serves as the major milk supplier to the urban market (Alemu et al. 2000; Holloway et al. 2000).

2.2 Consumption patterns

Milk and milk products form part of the diet of many Ethiopians. They consume dairy products either as fresh milk or in fermented or soured form. Getachew and Gashaw (2001) estimated that 68% of the total milk produced is used for human consumption in the form of fresh milk, butter, cheese and yoghurt, while the rest is given to calves and wasted in the process. Butter produced from whole milk is estimated to have 65% fat and is the most widely consumed milk product in Ethiopia (Table 1). Of the total milk produced, around 40% is allocated for butter while only 9% is reserved for cheese. Tra- ditional butter, which ferments slowly at room temperature, can be kept for a year or longer, offering rural consumers a readily storable and durable dairy product.

The consumption of milk and milk products varies geographically between the highlands and the lowlands and the level of urbanisation. In the lowlands, all segments of the population consume dairy products while in the highlands major consumers primarily include children and some vulnerable groups of women. The limited statistical data available on potential milk demand suggest that demand for milk will increase, at least in the urban centres and among the people with high purchasing power.

The demand for milk depends on many factors including consumer preference, consumer's income, population size, price of the product, price of substitutes and other factors. Getachew and Gashaw (2001) indicated that the demand for milk is inelastic with respect to income and price. In general, increasing population growth, rising real income and decreasing consumer prices are expected to expand the demand for milk and milk products. The population of Ethiopia is estimated to grow at 2.9% per year

while the urban population increases at a rate of 4.4%. Therefore, growth in population and income are expected to increase fluid milk consumption.

Based on the 1994 national population census of the Central Statistics Authority of Ethiopia, urban dwellers account for 15% of the total population of 63.5 million in 2000. It is estimated that 40% of the urban population (those with average income above Ethiopian Birr (ETB)[1] 350, or less than US$ 50) can afford to buy 20 litres of milk per month. A study by the Ministry of Agriculture in Addis Ababa indicated that effective demand for milk was about 36,240 t in 1995 and projected to reach 55,440 t in the year 2005. Similarly, the demand for butter was estimated to be 10,624 and 16,227 t in the year 1995 and 2005, respectively. The rural population is estimated to be 85% of the total population and its milk consumption largely depends on livestock holding. In the mixed crop–livestock keeping highland region, it is estimated that 50% of households own cattle of which 56% are dairy cattle. Consequently, most households have access to milk. Similarly, more than 80% of the households in the lowlands own cattle, significant numbers of small ruminants and camels. In this area, it is likely that all households consume milk (Getachew and Gashaw 2001).

1. ETB = Ethiopian Birr. In November 2003, US$ 1 = ETB 8.57.

3 Historical profile of the dairy sector

Recent political developments in Ethiopia coincide with three phases of dairy development policy. These include the imperial regime, characterised by almost a free market economic system and the emergence of modern commercial dairying (1960–74), the socialist (Derg) regime that emphasised a centralised economic system and state farms (1974–91), and the current phase under the structural adjustment programme and mar- ket liberalisation (1991 to present). The principal rationale for following the political regimes in identifying phases of dairy development in Ethiopia is that during each of these three phases, the country followed a distinct political path and development poli- cies that directly and indirectly influenced the dairy sector. These include land tenure and land policy, macro-economic policy and orientation of development efforts.

The data used to trace production trends during these three phases are obtained from the FAO statistical database on agriculture. Additional data were collected from various sources because no complete data set exists on the dairy sector in Ethiopia. However, reported values vary across differing sources. These disparities, coupled with generally poor data quality, mean that conclusions based on the aggregate data should only be taken as indicative. Although it would be interesting to examine growth within each of the production systems over the different phases of dairy development, available data do not permit such analysis.

3.1 The emergence of modern dairying in Ethiopia (1960–74)

In the first half of the 20th century, dairying in Ethiopia was mostly traditional. Modern dairying started in the early 1950s when Ethiopia received the first batch of dairy cattle from the United Nations Relief and Rehabilitation Administration (UNRRA). With the introduction of these cattle in the country, commercial fluid milk production started on large farms in Addis Ababa and Asmara (Hizkias 2000). Government intervened through the introduction of high-yielding dairy cattle on the highlands in and around major urban areas. The government also established modern milk processing and marketing facilities to complement these input oriented production efforts. Most interventions during this phase focused on urban-based production and marketing including the intro- duction of exotic dairy cattle, feeding with high ratio of dairy concentrated feed, modern dairy infrastructure and high management level (Annex 1).

To facilitate the growth of the sector, UNICEF established a public sector pilot processing plant at Shola on the outskirt of Addis Ababa in 1960. The plant started by pro- cessing milk produced by the large farms. The plant significantly expanded in a short period and started collecting milk from smallholder producers in addition to that

from the large farms. This led to further expansion of large dairy farms. During the second half of the 1960s, dairy production in the Addis Ababa area began to develop rapidly because of the expansion in large private dairy farms and the participation of small- holder producers with indigenous cattle facilitated by the establishment of the milk collection centres.

With the advent of modern dairying, the Government of Ethiopia established the Addis Ababa Dairy Industry (AADI) in 1966 to control and organise the collection, processing and distribution of locally produced milk. Further, with the help of UNICEF, the Shola plant was expanded in 1969 and several government-owned dairy farms were established to supply the formal market and to serve as demonstration centres for the large commercial farms. In addition, the government introduced regular programmes and projects for dairy development. The first effort, initiated by the governments of Ethiopia and Sweden, was the establishment of the Chilalo Agricultural Development Unit (CADU), later named Arsi Rural Development Unit (ARDU), between 1970 and 1980. The unit produced and distributed crossbred heifers and provided artificial insemination (AI) and animal health services, in addition to forage production and marketing (Staal 1995).

To create an autonomous body responsible for dairy development, the Government of Ethiopia established the Dairy Development Agency (DDA) in 1971. The DDA took over the responsibilities of AADI and assumed more tasks as well, including the pro- vision of services for increasing milk production and creating formal milk markets in urban areas outside Addis Ababa. Further, the Addis Ababa Dairy Development Project (AADDP) was launched by the World Bank in 1971 with the objective of developing commercial dairy production and providing support for smallholder producers in the form of credit, imported cattle and technical services. By 1972, the DDA was receiving about 21 thousand litres of milk/day for processing, 57% of which came from 65 large farms (Staal 1995). In addition to collecting milk, the DDA sold milk and dairy products through its kiosks and shops as well as to institutions. It also facilitated the creation of dairy co-operatives to ease the provision of credit as well as technical and extension services to dairy producers.

Milk production in Ethiopia increased significantly during the 1960s. Between 1961 and 1974, milk production from all species increased by 16.6% from 637,375 to 743,100 t—an average annual growth rate of 1.63% (Table 2, Figure 2). This growth was largely due to the economies of scale in production as well as marketing, subsidies in transport to the formal market, secured land tenure and an active free market for feed and other inputs (Staal and Shapiro 1996). On a per capita basis, however, milk production declined during the 1961–74 period at an average rate of 0.87% per annum (Table 3). Dur- ing this period, butter and cheese processed using the traditional methods grew only slowly by about 0.1%. Processed milk production stagnated in the early 1960s but ex- panded significantly in the second half of the 1960s and early 1970s (Figure 2).

Table 2. Changing structure of milk production and distribution in Ethiopia.

	1985	2000
A. Volume of milk consumed (t)		
Imports of dairy products (milk equivalent)	279,651	8290
Large producers	26,407	34,536
Government enterprises	4657	1354
Large private producers	21,750	33,182
Small producers	853,823	1,116,664
Improved cattle	–	13,585
Indigenous cattle	–	1,103,079
Total	1,159,881	1,159,490
B. Number of dairy cattle		
Grade and pure dairy cattle under private and public		128,745
Of which smallholders own		32,204
Total		35,032,241

Sources: Getachew and Gashaw (2001); FAO (2002); and authors' calculation from DDE.

Table 3. Trends in total and per capita milk production (1961–2000).

	Milk production		Per capita production	
Period	Annual average	Growth rate[a] (%)	Average	Growth rate (%)
1961–1974[b]	698,555	1.63	24.07	–0.87
1975–1992[b]	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[c]

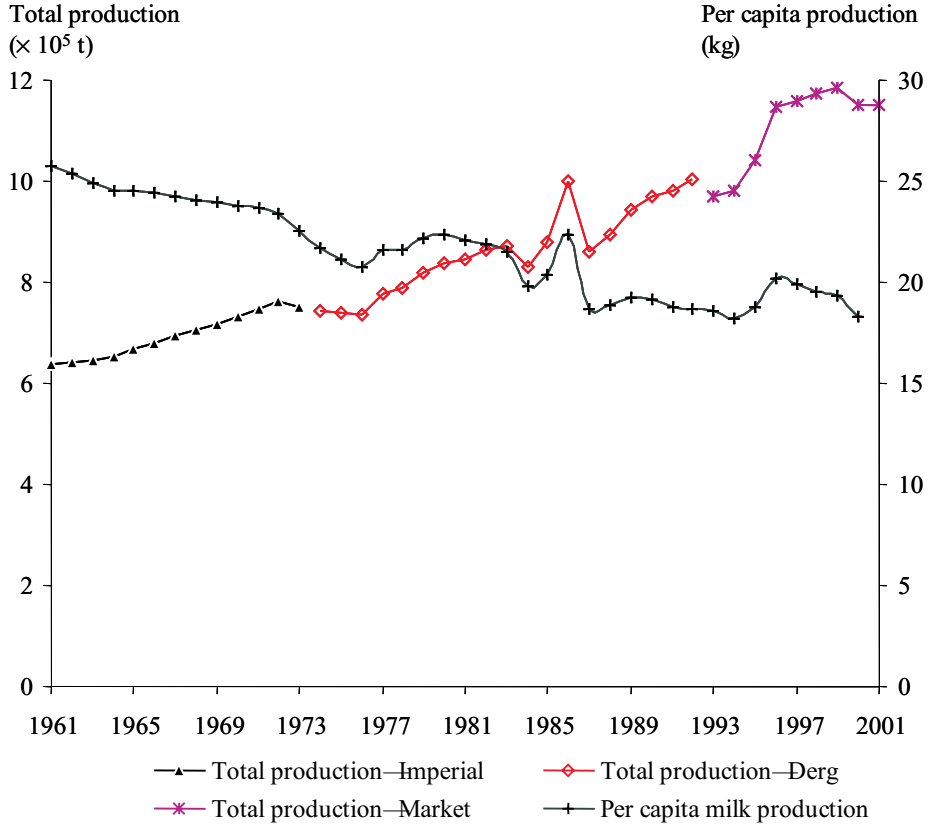
a. Growth rates were estimated statistically with an exponential function.
b. These periods refer to both Eritrea and Ethiopia, before the independence of Eritrea.
c. Statistically insignificant. All other growth rates are significant at 0.01 levels.
Source: FAO (2002).

3.2 Dairying during the Derg (1974–91)

Following the 1974 revolution, the Ethiopian economic policy shifted towards socialism. The DDA continued to operate until 1979 when it was merged with numerous other nationalised dairy farms to establish the Dairy Development Enterprise (DDE). DDE was established to operate the nationalised state farms, establish a milk collection net- work, process and market dairy products, provide advisory and limited

technical service to farmers, and sell veterinary medicaments and feeds to farmers. The enterprise had the capacity to process 60 thousand litres of milk at its inception.

During this phase, the government shifted attention from urban to rural producers. However, substantial resources remained devoted to establishing large-scale state farms to provide fluid milk for urban consumers. This phase was characterised by intensive efforts by the government and donors towards developing the dairy sector through producers' co-operatives. The dairy development effort was geared towards rural producers who, in fact, were members of producers' co-operatives. Projects and programmes were im- plemented to improve dairy development focussed on producers, service co-operatives and peasant associations as major implementing partners. All the programmes were intended to bring about improvement in milk production and an increase in income through the introduction of improved feeding, breeding and health development pro- grammes while less attention was given to marketing and processing. The programmes and projects implemented included the Minimum Package Program



Source: FAO (2002).
Figure 2. Total and per capita milk production in Ethiopia (1961–2001).

(MPP), Addis Ababa Dairy Development Project (AADDP), Dairy Rehabilitation and Development Project (DRDP), Artificial Insemination Service (AIS) and Selale

Peasant Dairy Development Pilot Project (SPDDP) (see Annex 1). Although the programmes or projects implemented differed in their intensity, most of them were input-oriented.

Because of these promotional efforts, total milk production increased significantly during this phase with the exception of the mid-1980s when the country experienced a debilitating three-year drought (Figure 2). Despite the significant increase in aggregate milk production, per capita milk production was declining. This phase was characterised by low producer prices, which discouraged production, emphasis on co-operatives in rural areas to the neglect of the most important producers in urban areas. To bridge the gap between supply and demand, dairy imports increased significantly during the second phase beginning from 1978. This was partly due to increased food aid, World Food Programme (WFP) milk powder imports, and a level of dairy production development that lagged far behind the demand (Tsehay 2000). During the drought of 1985/86, im- ports reached a peak of 279,651 and 314,726 t in 1985 and 1986, respectively. Tsehay (2002) also indicated that import dependency rose steadily during this phase. For in- stance, dairy imports as a percentage of total consumption increased from 4.1 to 12.8% between 1977 and 1989. Commercial imports grew rapidly at 24.18% per year (Getachew and Gashaw 2001). Further, it is estimated that imported milk powder accounted for 23% of the Addis Ababa market.

3.3 Dairying during the transition to a market-oriented economy (1991–present)

With the downfall of the Derg regime in 1991, Ethiopia embarked on policy reforms that aimed to bring about a market-oriented economic system. Several macro-economic policy changes were implemented. The exchange rate policy was altered from a fixed-rate system to a more market-determined system. A major devaluation of the local currency took place in 1992 followed by a series of smaller devaluations. A system of foreign cur- rency auctioning was introduced in 1995 and later changed to an inter-bank system. This probably has discouraged milk and dairy imports. Similarly, a new land policy was dec- lared. Although land remained in the hands of the government, the new constitution drawn up in 1994 allows temporary leases and farmers have the right to use the land in- definitely, lease it out temporarily to other farmers, and transfer it to their children but they cannot sell it permanently or mortgage it. Most importantly, the system of land re- distribution that created land insecurity and uncertainty has been abolished in Amhara and Tigray regions.

In addition to these major policy reforms, the new federal government launched a new national development strategy named Agricultural Development-Led Industrial- ization (ADLI). The strategy seeks to bring about an improvement in the livestock sector by enhancing the quality and quantity of feed, providing improved animal feed and ex- tension services, increasing livestock health services and improving the productivity of local cows by artificial insemination while preserving the indigenous

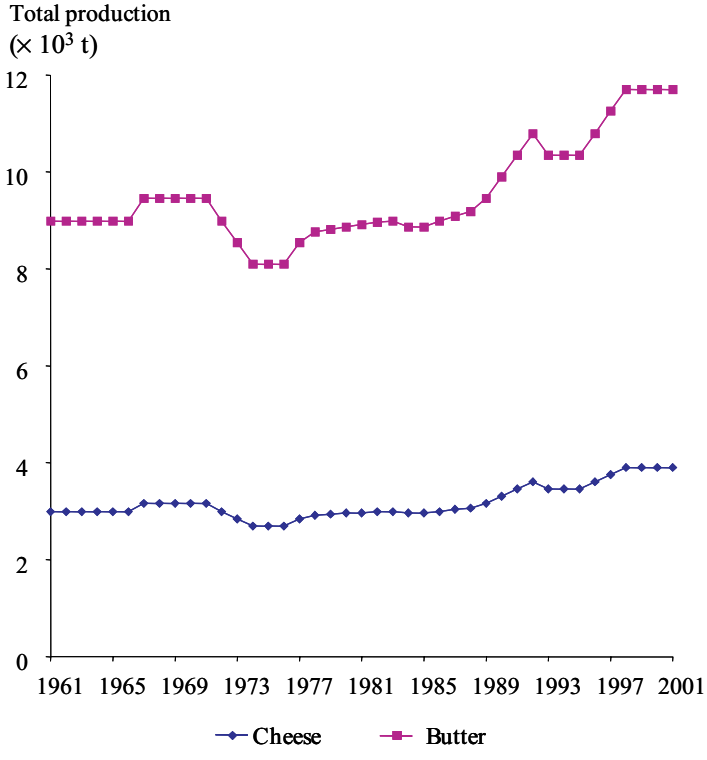
breeds (Benin et al. 2002). Although no clearly defined dairy development policy existed, it was envisaged that dairy policy would move increasingly towards private sector-led development. The policy recognises the potential of smallholder dairy production and accords due atten- tion to small producers although it also leaves room for the development of medium- and large-scale dairy farms in peri-urban areas. Activities undertaken include:

- use of the potential adaptive genetic merit of animals
- raising the quantity of feed available to livestock
- improving health, breeding and husbandry services
- encouraging the participation of private investors by improving income tax
- improving the delivery of artificial insemination
- developing and expanding efficient marketing systems in remote areas and
- organising farmers into milk producing, processing and marketing co-operatives (Getachew and Gashaw 2001).

In the third phase of the post-Derg market-oriented development, the private sector began to enter the dairy market as an important actor. Several private investors have now established milk-processing plants in Addis Ababa to supply fresh milk. Currently, the privately-held Sebeta Agro-industry is competing with DDE in supplying milk to urban consumers. DDE remains, however, an important actor in the formal dairy market. In 1993, the producer price paid by DDE increased from ETB 0.65 per litre to ETB 1.00 per litre and later to ETB 1.25. Meanwhile, the government privatised inefficient state farms, reducing the number of state farms from 14 to only 2. Moreover, the government accorded attention to the urban dairy producers and began serving them after the Min- istry of Agriculture (MOA) officially registered them.

Post 1991 producer groups such as the Addis Ababa Dairy Producers Association (AADPA) emerged encompassing 90% of all urban dairy producers and a large proportion of peri-urban producers within a radius of 100 km of Addis Ababa (Staal 1995). Dairy development efforts in the post-reform period have focussed on smallholder dairy producers. The two major donor-funded SDDPP and Smallholder Dairy Development Project (SDDP) projects focused exclusively on improving dairy production at the small- holder level. Unlike the projects implemented during the Derg regime, these two pro- jects addressed the marketing problems of smallholder producers in addition to the provision of inputs. Milk production grew faster in the post reform period at an annual growth rate of 3% (Table 3). Although per capita milk production stagnated during this period and grew at a positive but insignificant rate after the policy reform, this represents a reversal or termination of the negative trend in the growth of per capita production during the previous two phases (Figure 2). However, the production of butter and cheese stagnated in the post reform period (Figure 3). In order to gain insight into possible sources of growth in the third phase, an attempt was made to disaggregate the total consumption of milk into different production systems. Rough estimates from the FAO (2002) data and available information from DDE and Getachew and Gashaw (2001) indicated that the contribution of imports of milk to total consumption of milk declined from 24% in 1985 to less than 1% in 2000. At the

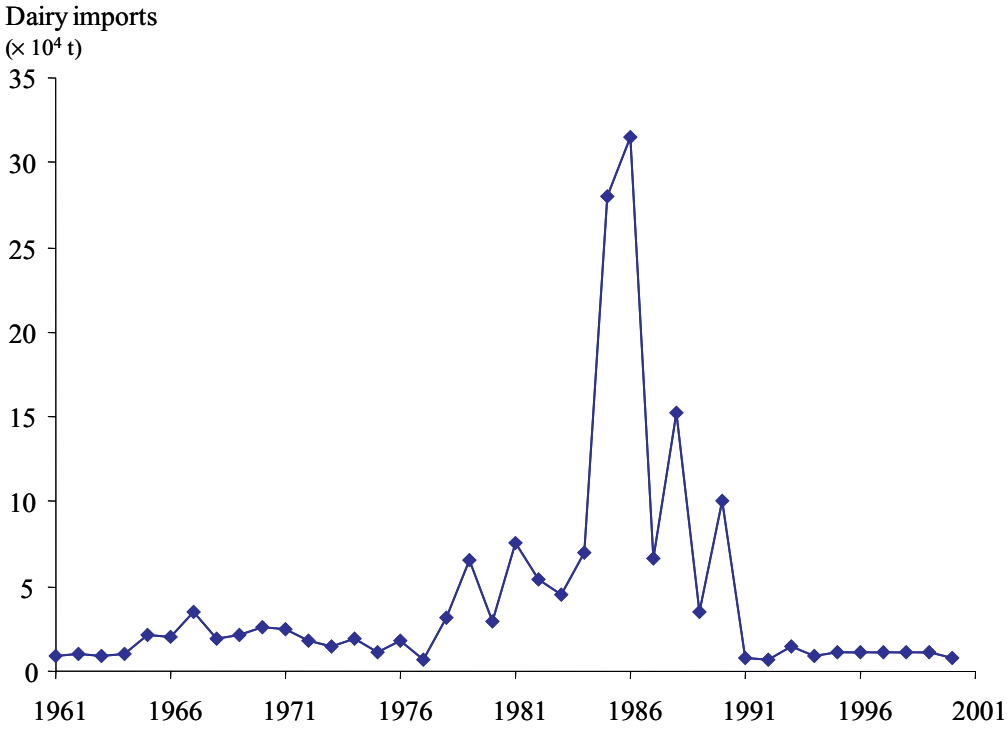
same time, the share of government- owned enterprises in total milk production decreased markedly. In contrast, the share of smallholder production in total consumption increased by 30%, from 71 to 96.6%. Of the total milk production from



Source: FAO (2002).
Figure 3. Butter and cheese production in Ethiopia (1961–2001).

smallholders, only 1.2% comes from improved cattle. This is not surprising because the sector contains only 32,204 heads or 25% of the total improved cattle. Similarly, the contribution of large private farms increased from 21,750 t in 1985 to 33,182 t in 2000 (Table 2). The increase in private sector production is mainly due to government policies such as privatisation of state enterprises, removal of input market controls and increased use of improved livestock that were in the hands of producer co-operatives and state farms.

To sum up, total milk production in Ethiopia increased during the 1961–2000 period at an average annual rate of 1.55%, though per capita production declined (Table 3) because of the high population growth rate. However, during the last decade pro- duction has been growing at an even higher rate (3%). The increased coverage of exten- sion services (such as better management skills) and increased use of improved inputs (improved breeds and feed) and policy changes promoting dairy production have con- tributed to faster growth of output. Dairy product imports during this phase were rela- tively smaller than in the earlier two phases (Figure 4). Most of the growth during



Source: FAO (2002).
Figure 4. Imports of dairy products (milk equivalent) in Ethiopia (1960–2001).

the third phase is concentrated in the peri-urban and rural production systems.[2] The emerg- ence of private processing industries and marketing units is likely to stimulate producers in the peri-urban areas and rural production systems as it offered producers a new mar- ket for their milk products.

2. Azage Tegegne, personal communication.

4 Dairy marketing systems in Ethiopia

As is common in other African countries (e.g. Kenya and Uganda), dairy products in Ethiopia are channelled to consumers through both formal and informal dairy marketing systems. Until 1991, the formal market of cold chain, pasteurised milk was exclusively dominated by DDE, which supplied 12% of the total fresh milk in the Addis Ababa area (Holloway et al. 2000). Recently, however, private businesses have begun collecting, processing, packing and distributing milk and other dairy products. The proportion of total production being marketed through the formal markets remains small (Muriuki and Thorpe 2002). Formal milk markets are particularly limited to peri-urban areas and Addis Ababa. However, unlike the early phases, the formal market appears to be ex- panding during the last decade with the private sector entering the dairy processing in- dustry in Addis Ababa and Dire Dawa in the eastern part of the country.[3]

DDE remains the only government enterprise involved in processing and marketing dairy products. DDE collects milk for processing from different sources, including large commercial farms, collection centres that receive milk from smallholder producers and, to a lesser extent, powder milk from the World Food Programme (WFP). The enterprise at present operates 25 collection centres located around Addis Ababa—13 of them near Selale, 5 near Holetta and 7 around Debre Birhan.

As the data in Annex 2 indicate, the total supply to DDE declined from 16.03 million litres in 1983/84 to 4.03 million litres in 1991/92. The state dairy farms were the de- pendable sources of milk for the enterprise supplying it with more than 45% of the total milk it processed between 1983 and 1991. But the share of state farms in milk supply to DDE fluctuated substantially after 1991 (Annex 2). This was mainly due to the reduced capacity following the sale of 12 state dairy farms and declining production from the remaining 2 farms due to feed shortage and management problems. To fill this gap, the share of private farms and smallholders increased significantly after 1991 and now ac- counts for over half of DDE's supply. DDE currently purchases milk from farmers at ETB 1.25/litre at the collection centres. It offers a price 15 to 25 cents less than that paid by private traders operating in the informal market (Zegeye 2000). Until the mid- 1980s, DDE charged a price of ETB 0.70 per litre of pasteurised milk. The price in- creased from ETB 1.00 in 1985/86 to ETB 1.70 in 1987/88 and ETB 2.15 in 1990. Currently, DDE charges ETB 2.85 per litre of milk.

DDE processes milk into pasteurised milk, butter, soft cheese, yoghurt, cream milk, formago (cheese) and ice cream (see Annex 3). The wide gap between production and sale of milk by DDE from 1980–90 reflects the failure of DDE to efficiently market its products. During the last decade, the period of transition to a market-oriented system, the marketing situation was improved and almost all the output was marketed. However, since its inception, the enterprise used its full capacity only during the four-year period from 1987 to 1990 (Staal 1995). The reasons for low capacity

3. Azage Tegegne, personal communication.

utilisation include manage- ment problems, financial difficulties, and unstable and low consumption levels of pro- cessed milk in the society due to fasting that prohibits the Orthodox Christians (about 35–40% of the population) from consuming dairy products for almost 200 days every year (Zegeye 2000).

In addition to DDE, several private milk-processing plants have been established in Addis Ababa, two of which—Sebeta Agro Industry and Dinsho dairy industries—have already started marketing their products. Although their share of the market is still small compared to DDE's, the entry of private firms in the formal milk market is a significant development indicating the profitability and potential of private investment in the dairy sector in Ethiopia and that the policy environment is facilitating such entry.

In recent years, promotional efforts have focused on dairy marketing. Milk-marketing co-operatives have been established by the SDDP with the support of the Finnish Inter- national Development Agency. These groups buy milk from both members and non- members, process it and sell products to traders and local consumers. The units also pro- cess milk into cream, skim milk, sour milk, butter and cottage cheese. The number of these milk co-operatives reached 32 in total—2 established by the FAO/TCP (Technical Cooperation Programme) and the World Food Programme (WFP) and 30 established by SDDP (Tsehay 2002).

The informal market involves direct delivery of fresh milk by producers to consumers in the immediate neighbourhood and sale to itinerant traders or individuals in nearby towns. In the informal market, milk may pass from producers to consumers directly or through two or more market agents. The informal system is characterised by the absence of licensing requirement to operate, low cost of operations, high producer prices com- pared to the formal market and no regulation of operations. The relative share and growth of the formal and informal markets in the three phases was different. In all three phases, the informal (traditional) market has remained dominant in Ethiopia.

Traditional processing and trade of dairy products, especially the traditionally soured butter, dominates the Ethiopian dairy sector (Table 1). Of the total milk produced only 5% is marketed as fluid milk due to the underdevelopment of infrastructure in rural areas.

5 Key policy and technology issues

5.1 Technology gap in Ethiopia

Advances in biological technology in livestock have been induced primarily to improve the yield of animal products per unit of feed or breeding stock (Hayami and Ruttan 1985). Analogous to the case of crop production, these advances typically involve one or more of the following elements:

- (improved feeding to provide satisfactory environment for animal growth and feed supplements to stimulate higher productivity
- disease control
- better environments for animal growth, particularly shelter and
- selection of efficient breeds specifically adapted to respond to those elements in the environment that are subject to man's control.

These advances raise two issues relevant to the dairy sector in Ethiopia—feed constraints and genetic improvement.

5.2 Feed constraints

Inadequate supply of quality feed and the low productivity of the indigenous cattle breeds are the major factors limiting dairy productivity in Ethiopia. Feed, usually based on fodder and grass, are either not available in sufficient quantities due to fluctuating weather conditions or, when available, are of poor nutritional quality. These constraints result in low milk and meat yields, high mortality of young stock, longer parturition in- tervals and low animal weights (McIntire et al. 1992, 103). Improved nutrition through the adoption of sown forage and better crop residue management can substantially raise livestock productivity. National and international research agencies, including the Inter- national Livestock Research Institute (ILRI), have developed several feed production and utilisation technologies and strategies to address the problems of inadequate and poor quality of feeds. So far, the adoption of these technologies in the Ethiopian highlands has been limited.

Unlike residue management, hay and silage making or adoption of forage legumes often involves the introduction of a new crop into the farming system. Therefore, how the new crop fits into the existing system is critical to successful introduction. In the case of forages, this is determined by the degree of crop–livestock interactions, forage and livestock product markets, the extent of market participation of forage growers and resource availability.

Depending on the degree of crop–livestock interaction, several polar cases can be identified. In livestock-specialised systems such as the pastoral systems in southern Ethiopia and Afar regions, the crop enterprise is not part of the household production unit. Households in these systems are typically subsistence-oriented and based on

seasonal milk production. The livestock herders are dependent on natural pastures and grazing areas and to some extent on grazing crop residues in crop systems after harvest. As such, the adoption of improved forages is irrelevant since livestock owners usually do not own cropland. However, a transition to agro-pastoralists occurs in different parts of pastoralist areas. In these emerging systems, improved forage is becoming increasingly feasible.

The other polar case is the crop-specialised farming system in which households are predominantly crop producers with limited livestock holdings, mainly small ruminants. In these systems, crop–livestock interaction is minimal. Typical examples include the savannah zones of western Africa. In this system, a necessary condition for the adoption of forage is the availability of external markets for forage and animal products (McIntire and Debrah 1987). This system is very limited in Ethiopia as most of the crop pro- duction systems also involve livestock as an integral component.

In the typical mixed crop–livestock farming system, the household has two integrated enterprises, crop and livestock production. Since in mixed systems households can grow and feed forages for their own animals without recourse to forage markets, this system holds the highest potential for the adoption of improved forages. Also, forages prove use- ful in this system to support livestock during periods of low availability of crop residues and natural pastures, such as during the cropping season. In addition to contributing to livestock production, forage legumes contribute significantly to soil nitrogen and provide a break in cereal-dominated rotations (McIntire and Debrah 1987).

Empirical analysis of the adoption of forage in dairy farms in mixed farming systems has taken place in the Holetta area where forage technology has been introduced in association with improved dairy production. The empirical results suggest that the potential for the adoption of improved forage is high where both livestock productivity and response to improved feed technology are high, as with crossbreed cows, and where pro- duction is more market-oriented, as with dairy. Here, the potential for adoption is high because of the possible complementarities between regular cash income generation from dairy sales and the opportunity for intensification of crop production. Factors affecting adoption also appear to be interrelated such that the effect of one factor may influence adoption through its impact on another factor. For instance, crop intensification through increased use of purchased inputs eases land constraints and may lead to intensification of livestock production via improved feeding strategies.

5.3 Genetic improvement

Unlike Kenya, the large cattle population of Ethiopia has relatively limited numbers of exotic dairy cattle and their crosses. Less than 1% of the 34.5 million cattle population of Ethiopia are exotic or crossbred dairy cows (Muriuki and Thorpe 2002). Although it was difficult to trace the ownership of improved dairy animals, it is estimated that state and private farms own a total of 128,745 grade and pure female dairy animals of which the smallholders sector owns 32,204 crosses and improved female dairy cattle.

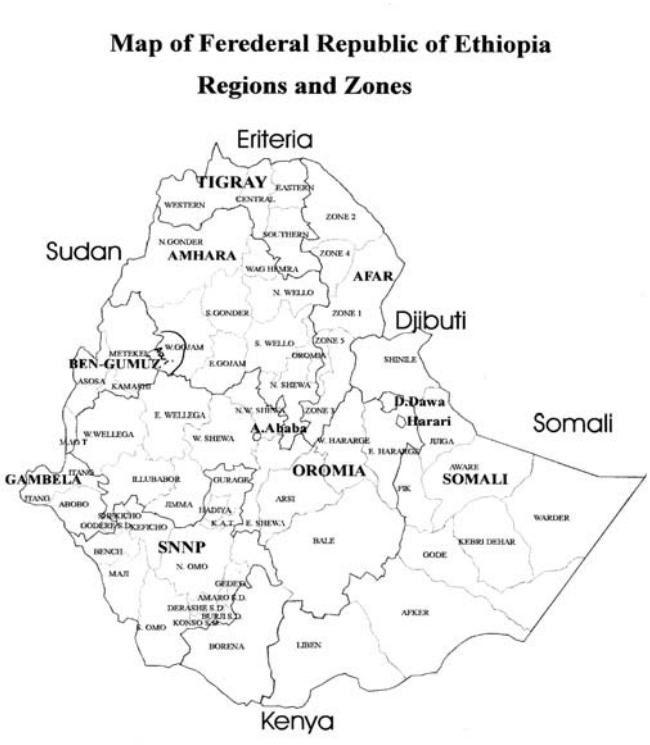
However, due to the dissolution of producer's co-operatives and the privatisation of state farms, most of the crossbreed cows are currently privately-owned in peri-urban and urban areas of the country (Getachew and Gashaw 2001). Consequently, milk productivity in Ethiopia is low. The indigenous zebu breed produces about 400–680 kg of milk/cow per lactation compared to grade animals that have the potential to produce 1120–2500 litres over a 279-day lactation.

Genetic improvement has been recognised in the design and implementation of the development projects in the country during the last four decades (Annex I). With the exception of SDDP, the production and distribution of crossbreed heifers, the provision and distribution of dairy stocks, the provision and strengthening of AI services, and/or bull service were major components of the development projects implemented between 1967 and 1998. Through the effort of these projects, Ethiopia has built up a herd of 120 thousand exotic cattle. So far, only one government institution, the National Artificial Insemination Center (NAIC) provides AI services in the country. The service is available in urban, peri-urban and rural areas.

All regions except Tigray, Somali and Gambela appear to have benefited from the dis- tribution of crossbred heifers (Figure 5). However, most of these projects—except two— failed to address the genetic improvement and the feed shortage problem simultaneously. The energy deficit resulting from poor quality or low quantity feed, especially during the dry season, could result in losses in body weight and body condition, thus affecting the production and reproduction efficiency of the cows (Zerbini et al. 1998). Besides, cross- breeds may need specialised management and veterinary health care. These were also not addressed in these projects. The only development project that addressed these issues simultaneously, beside marketing and processing, agroforestry and water development, was the Smallholder Dairy Development Project supported by the Finnish International Development Agency and implemented between 1995 and 1998 in 16 woredas in three regions.

5.4 Smallholder participation in the dairy market

Enhancing the ability of poor smallholder farmers to reach markets and actively engage in them poses a pressing development challenge. Difficult market access restricts opportunities for income generation. Remoteness results in reduced farm-gate prices, increased input costs and lower returns to labour and capital. This, in turn, reduces incentives to participate in economic transactions and results in subsistent rather than market- oriented production systems. Sparsely populated rural areas, remoteness from towns and high transport costs all pose physical barriers impeding market access. Transaction costs such as lack of information about markets, lack of negotiating skills, and lack of collec- tive organisation are other impediments to market access. The question of how to ex- pand the market participation of smallholder livestock producers is a major challenge facing many governments and non-governmental organisations (NGOs) in developing countries.



N.B. Triangles represent distribution points.
Figure 5. Distribution of crossbred heifers in Ethiopia.

A study carried out by ILRI using SDDP project data in Selale indicates some import- ant points to be considered in introducing new dairy technologies. The policy-relevant variables having the greatest impact in fluid milk markets are cow numbers, time to the milk group and visits by an extension agent. The number of cows kept affects marketable surplus through total production and marginal costs of production (Holloway et al. 2000). The action of pooling, especially pooling of milk collection and transportation activities, has the potential to mitigate costs. Reducing the milk delivery time from farm to collection point can increase sales to the milk group. This clearly relates to the trans- action costs of reallocating family labour to milk delivery. Currently, many potential fluid milk-marketing households are hours distant from any milk collection points. Any policy support to raise smallholder participation in milk marketing would necessarily need to weigh public costs against the expected gains by smallholder households.

Market access poses a key bottleneck to the expansion of smallholder milk pro- duction and processing. Milk groups and co-operatives increase the participation of

smallholders in fluid milk markets in the Ethiopian highlands. Milk groups are a simple example of an agro-industrial innovation, but they are only a necessary first step in the process of developing more sophisticated co-operative organisations. The survival of the milk groups will depend on their continued ability to capture value-added dairy pro- cessing and retain the value-added for their members. The cost of milk production in Ethiopia is low but transaction costs are high, preventing current dairy exports. Milk groups, when developed further, could serve as basis for the development of producer-oriented processing that better integrates smallholder producers with the Ethiopian dairy markets and the global agro-industry. Boxes 1 and 2 present two illustrative cases of milk groups.

Box 1. A dairy marketing association

The Adaa Liben Woreda Dairy and Dairy Products Marketing Association was founded in September 1999 in Debre Zeit town, 50 km south-east of Addis Ababa. It has 34 founding members with a single share of ETB 100. The initial capital of the association was thus only ETB 3400. The amount of milk collected from the founding members was 308 litres per day or about 24 thousand litres per month. The association, though informally established in 1997, got its certificate of registration from Oromiya State in September 2000.

Over the last few years, the association has grown significantly, and by June 2002, full membership had increased to a total of 426 members, with 245 male and 183 female dairy farmers. The total number of dairy cattle owned by the members is 1716. In addition, 181 non-member dairy farmers also supply milk to the association. Consequently, the current capital of the association has increased to ETB 500 thousand and milk collections have reached 174,360 litres per month in 2002, up by a factor of seven from the 24 thousand litres supplied monthly in 1999. There are seven milk collection sites in and around Debre Zeit town. Recently, the association purchased two coolers with a 25 thousand-litres capacity.

Box 2. Addis Ababa Dairy Co-operative

The Addis Ababa Dairy Co-operative is the pioneer co-operative in Addis Ababa and its surrounding areas. The co-operative was first established in December 1992 with the aim of facilitating the supply of feed for urban dairy producers. By 2002, the number of members in the co-operative had reached 171, and almost half of them (85) were women. The current capital of the co-operative amounts to over ETB 61 thousand and each member on average owns 10 dairy cattle. Currently, the average milk collection per member is 20–30 litres per day or about 102,600 to 153,900 litres per month.

5.5 Lessons from the neighbours

The superior performance of Kenya's dairy sector offers several lessons to Ethiopia, whose dairy sector remains in its infancy. First, grade cattle provided the major source of increased productivity in Kenya. Hence, smallholders in Ethiopia should also be assisted to acquire grade cattle to increase productivity. Second, the development of effective infrastructure for the collection of milk in Kenya has also played a very important role in the development of the dairy sector in the country. This was made possible because the Kenya Cooperative Creameries (KCC) provided a guaranteed market for smallholder's milk. However, Ethiopia's DDE, the major public enterprise engaged in the collection and processing of milk from smallholders and private farms, is operating below full capacity and has not played a comparably significant role as market outlet or buyer of last resort. Hence, the enterprise needs to increase its efficiency and raise its collection network. The milk co-operatives should also be given enough technical and financial support to continue to serve as an important market outlet for smallholder producers. Currently, only a few milk processing industries operate, and these are limited to the capital and a few regional towns. The emergence of these private agro-industries has given the smallholders and peri-urban producers an alternative market to the DDE. Hence, the private sector should be promoted to engage in dairy processing and mar- keting to provide opportunity for smallholders to market their milk. The input market should also be liberalised and the private sector promoted to actively participate in the market. More importantly, the success of the dairy sector in Kenya was driven by in- creases in demand. Yet, this has not happened in the case of Ethiopia. Therefore, stimu- lating the consumption of milk and milk products in the major cities and townships through increasing awareness is important for the sustainable development of the sector.

Milk production and marketing systems are similar in Kenya and Ethiopia (Muriuki and Thorpe 2002) and smallholders dominate dairy production in both countries. Both countries have parallel formal and informal marketing systems where the proportion of

milk production marketed in the formal market constitutes a very small portion of the total milk produced (Muriuki and Thorpe 2002). In Kenya, the proportion of marketed milk sold in the formal market is 15% compared to only 5% in Uganda and a negligible share in Ethiopia (Muriuki and Thorpe 2002). With agro-industrial development of the dairy sector in Ethiopia coming through private investment, the proportion of marketed milk sold in the formal market is expected to increase.

Despite the agro-ecological similarities between Kenya and Ethiopia, the Kenyan highlands have higher and more evenly distributed rainfall and hence higher potential for feed and forage production. In Ethiopia, on-farm feed and forage production as well as industrial concentrate need to be emphasised.

Since the major part of the demand for dairy products in Ethiopia is mainly for processed milk (butter and cheese), smallholder, labour-intensive processing technologies should be encouraged. Such technologies—hand-driven churners—are available and are used by women in rural areas for butter production. In the future and as income grows, demand for processed dairy products such as ice-cream and yoghurt is expected to grow.

6 Impact of smallholder market-oriented dairy on households

In the typical mixed crop–livestock system of the highlands of Ethiopia, farming households produce milk using local zebu cows that are kept on communal pasture and crop residues. Milk productivity is low and most of the product is retained for home consumption. The small surplus may be processed into butter and cheese and either consumed or sold. In contrast, improved dairy technology based on high-yielding crossbred cows and production of improved forages has the potential for increasing milk production by smallholder households for both home consumption and the market. The household impacts of smallholder, market-oriented dairying has been analysed to test whether gains in real income from technical change or commercialisation may translate into food consumption of the poor and nutrient intake in a pilot research project implemented in the Holetta[4] area between 1993 and 1998 (Ahmed et al. 2000; Ahmed et al. 2002). The research project was aimed at evaluating the feasibility of using crossbred cows for both dairy and draft under farmers' conditions.

The pilot project site is located in the Ethiopian highlands, about 40 km west of Addis Ababa, in the vicinity of Holetta town. The altitude of the research area is about 2600 masl. The farming system in the study area is classified as a mixed crop–livestock system with livestock playing an important role in the provision of food (milk and meat), draft power and dung, which is used mainly as a source of fuel as well as for soil fertility enhancement.

The dairy technology consists of crossbred cows, improved feed technology such as on-farm production of forages and improved management. Pairs of crossbred dairy cows were initially introduced to 14 farmers in Holetta in 1993, half for milk production only and the other half for dairy and draft. In 1995 and early 1996, 120 more crossbred cows were sold on credit to an additional 60 households. Some households other than those participating in the project also owned crossbred cows. Willingness and ability to pay the initial down payment and costs for maintaining the crossbred cows were the major cri- teria used for selecting the participating households. Although the initial 14 farmers were relatively rich, the latter sixty farmers were selected from a list of farmers in three wealth groups, namely poor, medium wealth and rich farmers. Sixty control households using traditional practices of local zebu cows for milk production and oxen for traction were included in the household surveys beginning in mid-1995. The number of control farmers in each wealth group is roughly equal to the number of crossbred cow owners in the same wealth group. Within each wealth group, participating and control households were comparable, selected on the basis of the same criteria.

4. In recent years, smallholder dairy technology consisting of crossbred cows, improved feed and improved management practices has been introduced throughout the highlands of Ethiopia (see Figure 5). The case in Holetta differs only with respect to the marketing potential of fresh milk due to its proximity to the Addis Ababa market. However, the introduction elsewhere is expected to have produced a comparable impact.

Based on the profile of adopters and non-adopters (Table 4), household heads of both groups tend to be of similar average age and education. Households in both groups have comparable size in terms of adult equivalence, dependents and labour resources. However, adopters have more farm area, allocate more area to food crops and smaller local breed livestock herd size in addition to 1.69 crossbred cows on average.[5] Because of the higher income from improved dairying, adopting households earn significantly higher per capita income and spend more on household consumer items as well as on farm inputs. In addition, per capita intake of calorie, protein and iron is higher in adopting households.

Table 4. Profile of adopters and non-adopters of improved market-oriented dairy in Holetta, Ethiopia.

Variable	All cases	Participants (adopters)	Non-participant (non-adopters)
Number of observations	147	78	69
Per capita annual income (ETB)	1435	1663[a]	1178
Per capita annual cash expenditure on food	160	168	151
Per capita annual cash expenditure on non-food	169	178	159
Household expenditure on farm inputs	1199	1382[a]	988
Proportion of cash income	0.37	0.41[a]	0.32
Per capita nutrition intake			
Calorie (Calorie)	2354	2511[a]	2177
Protein (gm)	72	76[a]	67
Iron (mg)	118	131[a]	103
Farm area (ha)	2.97	3.32[a]	2.58
Area allocated to food crops (ha)	2.3	2.44[c]	2.15
Input use per hectare (ETB)	375	379	369
Local breed herd size (tropical livestock unit, TLU)	6.23	5.55[b]	7
Number of crossbred cows	0.91	1.69[a]	0
Labour units in adult equivalents	3.09	3.06	3.13
Adult equivalent size of the household	5.79	5.72	5.89
Age of household head	45	46	45
Age of mother or spouse	37	37	37
Dependency ratio	0.39	0.4	0.38
Women ratio	0.48	0.45[b]	0.51
Illiterate head of households (%)	0.29	0.26	0.32
Head of households with high school education (%)	0.14	0.15	0.14

a, b and c means of the two groups are significantly different at 1, 5 and 10% level, respectively.
Source: Ahmed et al. (forthcoming).

5. Hereafter, adopters refer to households owning crossbred cows.

Within the study area, crossbred cows yield a gross margin of ETB 937/cow per year, or more than seven times the gross margin of a local cow (ETB 120), in 1997 (Table 5). This result mirrors a similar study by SDDP on the central highlands of Ethiopia in 1998, which shows a gross margin of ETB 865/crossbred cow per year with an annual milk production of 700 litres (Ojala 1998). Crossbred cows yield 37.2 litres of milk/cow per labour day, which is twice the yield/cow per labour day of the local breed. Although crossbred cows require a higher variable cost than local cows, the gross margin per unit variable cost was still higher than local cows indicating the profitability of crossbred cows (Table 5). This result compares favourably with the results of recursive econometric ana- lysis, which indicates significant productivity gains from crossbred cows as compared to local breeds.

Table 5. Gross margin for crossbred and local breed cows.

Item	Local breed cow	Crossbred cow
Milk in litre	134.07	783.68
Milk revenue (cash sales only, ETB)	140.77	822.87
Meat production (ETB)	67.00	107.00
Heifer surplus (ETB)	47.00	326.00
Value of manure (ETB)	148.00	236.00
Gross revenue (ETB/cow per year)	402.77	1491.87
Variable costs (ETB)		
Feeding of cow	135.00	217.00
Feeding of heifer	134.00	173.00
Purchased feed	11.53	153.66
Health care, AI service	1.42	11.00
Total variable cost	281.95	554.66
Gross margin	120.82	937.21
Labour (person days)	8.33	21.87
Value of labour (ETB)	41.67	109.34
Gross revenue per labour day (ETB)	16.89	37.62
Gross margin per labour day (ETB)	14.5	42.87
Gross margin per unit of variable cost (ETB)	0.43	1.69
Capital costs (ETB)	890.00	4070.00

Note: In November 2003, US$ 1 = ETB 8.57.
Source: Authors calculation and Abebe Misgina (personal communication).

A recursive econometric model was estimated based on the conceptual framework of the impact of the market-oriented dairy production (MODP) at a household level pre- sented in Annex 4. In this framework, high productivity of crossbred cows and comp- lementary technology may result in a higher milk and dairy production. Adopting house- holds may use the additional cash income for buying food, meeting other household needs, or purchasing farm inputs. The impact of dairy technology on

nutrition and health may result from direct increases of household consumption of milk and dairy products. The impact can also be indirect through higher household expenditure on food, health and sanitation or both. It has been well established by nutritionists that the consumption of more dairy products results in a better human nutrition and health (Neumann et al. 1993). Thus, we expect children of the adopting households who con- sume more dairy products to be healthier.

6.1 Impact on per capita income

In the recursive system, per capita income is defined as the market value of crop and livestock production and income from all other sources and estimated as a function of productive resources of the household and socio-economic characteristics of the household (Ahmed et al. 2002). Households earn income from production of crops and livestock including dairy, and renting resources such as land and labour. Crop production is a major source of income. Accounting for 61% of the income on average, this share is slightly higher (at 67%) for the control group and slightly lower (55%) for the adopters. Animal production constitutes 34% of the income of the MODP participants, and only 15% for the non-participants. Per adult equivalent income in the study area is generally low with a significant difference between the two groups of households. This difference is mainly attributed to the difference in dairy production.

As expected, the adoption of dairy and associated technology is a significant determi- nant of household income. The estimated coefficient of 0.51 on per capita crossbred cows owned translates into an income elasticity of 0.465 at the mean value of per capita holdings of crossbred cows (0.91 cows). The mean per capita income of an adopting household is 41% higher (ETB 1663) than that of a non-adopting household (ETB 1178) (Table 4). This is a substantial contribution attributable to ownership of crossbred cows and the adoption of associated feed and management technology. This increase comes mainly from the additional milk sales.

Local breed livestock herd also contributes significantly to per capita income in this mixed crop–livestock system, as indicated by the positive and significant coefficient of 0.12. Local livestock may contribute to household income indirectly through the provision of draft power to crop production and directly through animal sale and milk production for sale. Households with local breeds generate on average 15% of their income from livestock, mainly from live animal sales. However, the contribution of local breed livestock is much smaller than that of crossbreed cows.

Crop markets appear to be an important institution for rural households for facilitating profitable transactions and income-generating opportunities. The longer the travel time to the crop market, the lower the per capita income of the household. Longer travel time may discourage cash transactions, constrain the flow of market information es- pecially on prices and availability of inputs, add to transaction costs of purchases and sales and shift labour from production activities. In this analysis, the estimated elasticity of income with respect to distance to crop market is –0.137.

Tangka et al. (2002) showed the positive and significant effects of dairy technologies on food security and food production in the same area. These effects are reflected mainly through their impact on incomes and wealth. Besides, women in households with cross- bred cows earned nearly seven times more dairy income than women in households with only local cows. The average monthly non-dairy farm and off-farm incomes between the two groups of households were not statistically different, suggesting that the higher house- hold income in crossbred cow households came mainly from dairy products (Tangka et al. 2002).

6.2 Impacts on household expenditure patterns

Household expenditure can broadly be disaggregated into expenditure on food, non-food and farm inputs. Theoretically, expenditure on food includes value of food produced and consumed by the household. However, for lack of data, expenditure on food is defined here as cash expenditure on food and includes goods that are not produced by the household in addition to purchases of food to close any food deficit. Non-food ex- penditure includes household expenses such as clothing, health care, education and social contributions. Expenditure on inputs covers farm inputs such as fertiliser, chemicals and seed and livestock expenditure such as feed and veterinary expenses. Expenditures on food and non-food items are computed on a per capita basis while expenditure on inputs is computed for the household. The three relationships are estimated as functions of per capita income, proportion of cash income in total income, per capita area allocated to food crops, round-trip time to the nearest crop and livestock markets, and household socio-economic characteristics. Average annual per capita cash expenditure on food is estimated at ETB 40 and ETB 34 for the MODP participants and the non-participant households, respectively, with a statistically significant difference between the two groups (Table 4). These estimates are low mainly because these farm households con- sume most of their own food. Adopters have higher cash expenditures for farm inputs, transportation, tax and debt repayment, milling and clothing, which add up to higher but not significantly different total cash expenditures.

The coefficients of the income variable in the three equations are positive and statistically significant. Expenditure elasticity of income is highest in the case of farm inputs (0.99) and lowest for non-food expenditure (0.21). This result indicates that income in- crements from technology adoption and commercialisation do not necessarily translate fully into additional food purchases but are distributed among the alternative needs of the households. It is worth noting that doubling income almost doubled expenditure on inputs indicating the high priority for increasing future income earnings from the use of purchased farm inputs. This also reflects the willingness of households to adopt improved crop technology such as improved seed and fertiliser. The high proportional increase in farm input expenditure from increments of income from adoption of the dairy tech- nology suggests that livestock intensification through the introduction of improved pro- duction technology may lead to intensification in crop production.

The proportion of cash income in total household income measures the degree of market participation of the households. This proportion is significantly higher among the improved dairy households (Table 5). Sales of dairy, livestock and surplus crop are the major sources of cash for households. As the proportion of cash income increases, expenditure on both food and non-food items increases significantly. However, the proportion of cash income does not affect the expenditure on inputs, as credit is an alternative source for input purchases. Credit may be substituted for cash income allowing a household to spend more on other expenditures. At the mean, the elasticities of food and non-food expenditure with respect to the proportion of cash income are 0.30 and 0.61, respectively. These results suggest that technologies that increase productivity of a cash commodity such as dairy and other livestock technology also promote market par- ticipation through increased expenditures on food and non-food goods consumed by the household. This may generate significant growth linkages in the rural economy.

6.3 Impact on nutritional intake

It is hypothesised that the income impact of adoption of dairy technology transmits recursively through expenditure effects to influence nutrient intakes. Average per capita daily nutrient intake functions—for calories, protein and iron—are estimated as functions of per capita expenditure on food, per unit price of the nutrient, area allocated to food (cereals and pulses) as a proxy for food produced at home, and socio-economic factors of the household.

On average both the MODP participant and non-participant households meet this minimum. MODP participants consume about 15% more calories, 13% more protein and 27% more iron compared to the non-participants (Table 4). Statistically, however, these differences are not significant. As discussed earlier, the contribution of the MODP to household nutrition may come not only through direct consumption of milk but also through substitution effects due to the impact of improved dairy production on market integration. Also, the diets may not change significantly as most households will stick to their usual diets. However, the main gains may be for the households that face de- ficiencies.

Expenditure on food is a significant determinant of the intake of all three nutrients with estimated elasticities of 0.317, 0.326 and 0.193 for calorie, protein and iron. This supports the study hypothesis that increasing household incomes through the adoption of improved technology leads to improving household nutrient intakes and, therefore, contributes to better nutrition and health.

There is a significant and negative relationship between the unit prices and nutrient intakes. The demand for these nutrients is relatively inelastic with own price elasticities of –0.39, –0.77 and –0.70, respectively. This reflects the degree of response of the house- hold to the cost of high-nutritive meals such as meat, dairy and vegetables. This may explain the fact that households with dairy crossbred cows consume 22% more milk than households without crossbred cows due to the perceived lower cost of own pro- duction. This also suggests an inverse relationship between the cost of food and the

quan- tity prepared by the household. Unfortunately, these elasticities cannot be compared to estimates from other studies as in these studies commodity prices were used directly as regressors. The estimates obtained here are with respect to a weighted price index that depends on the cost of individual ingredients used in meal preparation.

Nutrient intakes significantly increase as household food production (as measured by area allocated to staple crops) increases. This is clearly because food produced on farm constitutes the major source of household food consumption and hence, nutrient in- takes. There is an inverse and statistically significant relationship between the age of mothers and the per capita protein and calorie intake. This may be due to the likelihood that young mothers may have received more formal education due to the recent increase in the availability of schooling and more exposure to nutritional information. Male- headed households tend to consume significantly less energy and protein while house- holds with more children consume significantly more calories.

To sum up, the assessment of the household impacts of adopting market-oriented dairy production which consists principally of crossbred cows and improved feed and management practices by smallholder households in rural Ethiopia demonstrates that market-oriented dairy technology significantly raises per capita income and income effects extend positively to expenditure and consumption. The higher the income level, the higher the expenditure on food, non-food items and farm inputs. On the other hand, expenditure is directly related to nutrient intakes. The resource base, including cultivated area and capital inputs, are also important determinants of per capita income.

From a policy perspective, these results imply that the introduction of market-oriented activities is an effective way of reducing poverty and malnutrition of smallholder households in rural areas. Moreover, such introduction has the potential to stimulate the rural economy through demand stimulus for non-food. The enabling environment for the success of such activities includes marketing infrastructure and the availability of farm inputs and essential veterinary services for dairy farmers. Policies that encourage farmers' participation in markets and cash income generation appear to be critical.

6.4 Farmer perceptions of the benefits of crossbred cows

According to smallholder farmers who participated in the dairy project in Holetta, keep- ing crossbred cows has brought significant changes to their lives. Recent interviews in Holetta area indicate that crossbred cows have improved households' access to food, es- pecially dairy products. This has helped them to raise healthy children through increased consumption of dairy products. Moreover, the benefits of crossbred cows go far beyond household consumption. Farmers were also obtaining cash income from the sale of sur- plus milk, milk products and heifers. This increased their ability to buy fertilisers and improve their living standards by building decent houses and sending their children to school. Unlike crop production, which is seasonal,

market-oriented dairying was more sustainable throughout the year in terms of generating cash income and hence, allows savings (Boxes 3, 4 and 5). According to the farmers, the benefits include access to dairy products for consumption and urine and manure for sustainable income. These in turn help them for the repayment of debts and household expenditure for such items as schooling, buying clothes and asset building.

Box 3. Farmer Fekeru Getachew on the benefits from dairying

Fekeru Getachew is a young farmer. In 1995, he was among poor farmers who owned only one ox. Then he received two crossbred cows on credit. After eight years, he says, 'I have an entirely different way of life and I witnessed visible changes to the house- hold.' In addition to the two crossbred cows he currently has five draft oxen that he bought by selling the crossbred heifers.

Fekeru believes that crossbred cows have brought many benefits to his family. 'To mention some', he said, 'I am now a father of three well-fed and healthy children because we have always milk at our home.' Remembering his old days where there was no cooking oil, he said, 'Now, thanks to these cows, we have enough cooking butter than ever before'. The benefits of these cows were not only for household use as they are also a source of cash income for the family. The cash income from the sale of dairy products is used to send his children to school and to buy clothing. He said that the cash from the sale of dairy products and crossbred heifers is helping him also to repay fertiliser credits. 'In situations like dry seasons where the price of crops goes down, I am no more obliged to sell my produce at low prices. I rather use dairy products as alterna- tive sources of cash.'

Moreover, the fresh manure obtained from the cows has saved his wife from collecting fuel wood. However, he is facing problems such as inadequate feed supply and inadequate AI services. He said he has no doubt that the crossbred cows bring significant benefits. To sustain the benefits, he needs a regular supply of AI services and con- centrates.

Box 4. Farmer Gizaw Wendimu on the benefits from dairying

Gizaw Wendimu is a young secondary school graduate farmer. He said, 'I believe that I am a model to my neighbours because I have a better life since I received the two cross- bred cows in 1995.' He elaborates, 'I remember the day I learnt about crossbred cows with lots of joy. Since I brought the two crossbred cows in the house, we never had a problem of food and I have now two crossbred cows and two heifers.' Expressing his strong attachment to crossbred cows, he said, 'I couldn't imagine life with no milk and milk products in the future'. The crossbred cows, apart from helping him to have healthy children, are earning him income. He supplies the excess milk to a nearby hotel and to individuals.

Gizaw has also built a decent house with the cash he obtained from the sale of milk and other dairy products. As the dry period for crossbred cows is shorter than for the local breeds, the income he earns proves more sustainable over time. Hence, he was able to save and repay his fertiliser credit. 'I can see a better future with my crossbred cows', he said adding, 'I am, therefore, planning to build new barn for the cows'. He attributes the benefits he obtained to the new technology as well as the continued effort he is making on the management of crossbred cows. He thinks that dairying can be a way forward for many farmers like him if it is supported with extension services.

Box 5. Farmer Teklu on the benefits of dairying

Teklu is an experienced farmer who appreciates the benefits of adopting crossbred cows if they are managed properly. At the beginning he said, 'I had only four cows, and then I received two crossbred cows on credit in 1995. Currently, I have five heifers and three crossbred cows'. He added, 'I have benefited for the last eight years from the crossbred cows and for me the cow is just like a dedicated mother who never gets tired of taking care of her children'. Teklu has planted oats and vetch for his crossbred cows on the plot he used to plant teff because he discovered that the dairy income in only two months is twice as high as the income from planting teff on that plot.

Besides the consumption needs of his family, Teklu earned cash income from the sale of crossbred heifers and dairy products, which enabled him to build a new house in town. 'I also pay my debt regularly for fertiliser credit as the cows lactate for almost nine months per year. I keep my crossbred cattle at home and do not mix them with the local breeds during grazing', he said. This is intended to reduce the risk of diseases that can easily attack crossbred cows. Managing the crossbred cows for him is like nurturing a child, which should be done continuously and with no reluctance.

7 Conclusion and implications

Like other sectors of the economy, the dairy sector in Ethiopia has passed through three phases or turning points, following the economic policy and political history of the country. In the most recent phase, which is characterised by the transition towards a market-oriented economy, the dairy sector appears to be moving towards a takeoff stage. Liberalised markets, private sector investment and the promotion of smallholder dairy are the main features of this phase. Milk production during the 1990s expanded at an annual rate of 3% compared to 1.63–1.66% during the preceding three decades.

However, most of the growth in milk production (60%) was due to the increase in herd size. Only one-quarter was due to productivity per animal resulting from technological change. This is not surprising since dairy production in the country is principally dependent on indigenous zebu breeds. Therefore, the integration of crossbred cattle to the sector is imperative for dairy development in the country. This can be achieved in two ways: first, by promoting large private investment that will eventually introduce new technology in the sector such as improved genotypes, feed and processing; and second, as smallholders will likely continue dominating the sector, by integrating crossbred cattle into the smallholder sector thereby improving their access to improved cattle breeds, AI and veterinary services and credit. Meanwhile, the government should also take the lead in building infrastructure and providing technical service to smallholders.

Severe shortages, low quality and seasonal unavailability of feed likewise remain as major constraints to livestock production in Ethiopia. These constraints need to be addressed and technological change should be promoted in order to increase milk production.

Due to poor infrastructure, the concentration of milk producers in rural areas, seasonal fluctuation of demand for fresh milk, and its perishability, the development and promotion of small-scale processing technologies is critical to increasing the partici- pation of smallholder producers in the dairy market. This is particularly important for Ethiopia where the demand for dairy products is dominated by butter rather than fluid milk. In addition, enhancing the ability of poor smallholder farmers to reach markets, and actively engage in them, is one of the most pressing development challenges. Milk groups and co-operatives increase the participation of smallholders in fluid milk markets in the Ethiopian highlands. Milk groups are a simple example of an agro-industrial inno- vation, but they are only a necessary first step in the process of developing more sophisti- cated co-operative organisations and well-functioning dairy markets. The survival of the milk groups that supply inputs, as well as process and market dairy products will depend on their continued ability to capture value-added dairy processing and return that value- added to their members. Evidence from Kenya emphasises the importance of collection organisations in improving access to markets and expanding productive bases (Staal 1995). There is also the need to stimulate the consumption of dairy products in the country as low demand for dairy products can potentially discourage production in the long run.

Review of the development of the dairy sector in Ethiopia indicates that there is a need to focus interventions more coherently. Development interventions should be aimed at addressing both technological gaps and marketing problems. If the appropriate producer price incentives are in place and input markets are allowed to operate freely, dairy production may respond positively. This has been demonstrated in the case of dairy development in Kenya that has nearly similar agro-ecological and production systems.

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Annex 1. Dairy development projects implemented in Ethiopia, 1967–98

Project name	Duration	Objective	Major components	Area coverage
The first phase				
CADU/ARDU[1]	1967–84	To improve and promote meat and milk production in the region	· Production and distribution of crossbred heifers · AI service · Animal health · Forage production · Marketing	Chilalo awraja/Arsi
MPP[2]	1972–80	To raise the income and output of smallholder farmers with minimum reliance on scarce resources	· Distribution of crossbred heifers · Bull service · AI service	Almost all over the country except the lowlands
AADDP[3]	1972–81	To increase milk supply for the Addis Ababa market	· Provision of dairy stock · Marketing · AI service · Expansion of Shola plant	Addis Ababa and 110 km around Addis Ababa
The second phase				
DRDP[4]	1986–92	· To improve rural incomes and nutritional status of peasants	· Co-operative dairy farm development through the introduction of crossbred cows	10 provinces
		· To improve operational efficiency and financial performance of the state dairy sector	· State farm development	
		· To increase the supply of butter and milk to the capital and other major cities	· Health services	
		· To place dairying on sound footing		
SPDDP[5]	1987–91	To increase sustainable smallholder dairy production in the highlands of Ethiopia	· Dairy stock distribution	Former Selale awraja
			· Co-operative development	
SNAIS[6]	1987–90	To provide an efficient and reliable AI service	· Strengthening of AI service at field level	Kality AI centre and 8 provinces
The third phase				
SDDPP[7]	1991–94	· To organise small milk processing and marketing units that can raise income and nutritional standards of smallholder farmers	· Milk marketing and processing	Two woredas in Oromiya and SNNPS regions

cont'd...

Annex 1. cont'd.

Project name	Duration	Objective	Major components	Area coverage
		· To generate information and provide experience for future dairy development efforts		
SDDP[8]	1995–98	· To improve the standard of living of the smallholder farming families under friendly development approach	· Dairy stock distribution	16 woredas in three regions
			· Breeding bulls for distribution	
			· Milk marketing and processing	
			· Fodder production	
			· Agroforestry	
			· Water development	
			· Appropriate technology	

1. CADU/ARDU = Chilalo Agricultural Development Unit/Arsi Rural Development Unit.
2. MPP = Minimum Package Program.
3. AADDP = Addis Ababa Dairy Development Project.
4. DRDP = Dairy Rehabilitation and Development Project.
5. SPDDP = Selale Peasant Dairy Development Pilot Project.
6. SNAIS = Support for National Artificial Insemination Service.
7. SDDPP = Selale Dairy Development Pilot Project (phase II).
8. SDDP = Smallholder Dairy Development Project.

Annex 2. Milk delivered to Dairy Development Enterprise (DDE) for processing (1980/81–2000/01) in litres

Year	Source				Total
	State farms	Collection centres	Private farms[a]	WFP	
1980/81	5,137,730	3,018,319	1,326,742	–	9,482,791
1981/82	5,353,216	5,062,646	1,152,142	207,200	11,775,204
1982/83	5,768,714	1,500,078	1,088,001	335,000	8,691,794
1983/84	6,718,555	4,209,545	1,460,000	3,650,000	16,038,100
1984/85	5,579,342	1,876,473	834,096	2,963,500	11,253,411
1985/86	4,656,775	3,756,950	873,445	1,510,000	10,797,170
1986/87	4,714,199	4,571,622	997,383	1,422,500	11,705,704
1987/88	4,925,076	4,079,502	952,099	2,784,220	12,740,897
1988/89	4,388,960	3,351,079	878,488	3,554,500	12,173,027
1989/90	4,884,533	3,115,419	817,047	2,786,250	11,603,249
1990/91	3,366,963	2,013,372	485,172	1,640,500	7,506,007
1991/92	1,373,972	1,053,698	280,877	1,322,580	4,031,127
1992/93	1,002,960	1,065,548	105,855	450,760	2,625,123
1993/94	1,396,564	–	2,407,380	139,000	3,942,944
1994/95	2,159,000	–	2,471,836	150,000	4,780,836
1995/96	2,556,654	–	2,399,968	48,200	5,004,822
1996/97	2,351,634	–	2,116,793	129,050	4,597,477
1997/98	2,502,550	–	2,076,779	–	4,579,329
1998/99	521,763	–	479,452	–	1,001,215
1999/00	1,782,755	–	3,288,671	–	5,071,426
2000/01	1,353,591	–	2,501,790	–	3,855,381

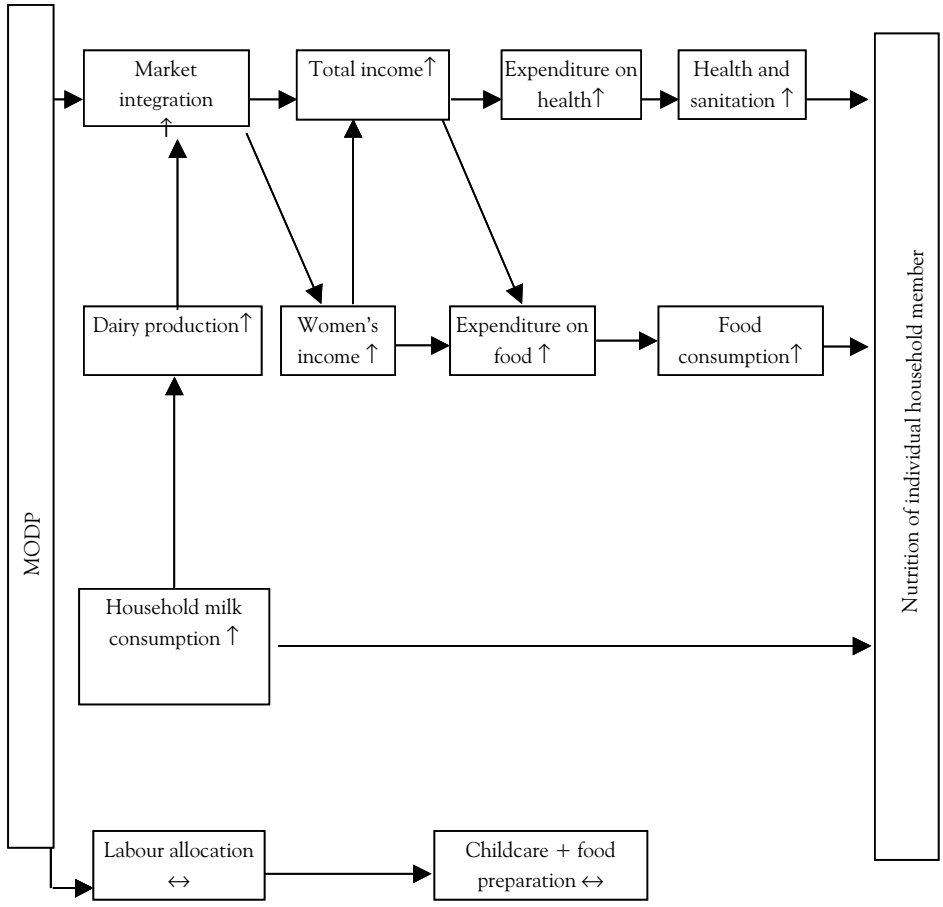
a. Starting from 1991, data in this column indicate milk collection from smallholders and private farms together.
Source: Dairy Development Enterprise (DDE).

Annex 3. Total dairy products sold by Dairy Development Enterprise (DDE)

Years	Milk (litres)	Butter (kg)	Soft cheese (kg)	Formago (kg)	Yoghurt (litres)	Cream (kg)	Icecream (kg)
1980/81	8,440,164	126,777	74,580	–		2983	–
1981/82	8,253,124	135,052	87,137	9406	989	1021	–
1982/83	9,539,207	147,157	85,848	15,168	2542	635	–
1983/84	1,070,994	110,635	62,050	24,515	–	736	–
1984/85	11,010,690	137,434	40,866	6755	–	629	–
1985/86	6,863,313	1,555,955	211,708	202,600	–	4516	–
1986/87	10,380,663	167,360	95,875	29,886	–	–	
1987/88	12,662,318	197,720	54,269	27,898	514	1658	
1988/89	8,552,482	1,467,630	86,798	277,433	6299	33,816	32,244
1989/90	7,706,565	1,814,280	214,819	186,038	8169	50,248	18,740
1990/91	8,055,752	1,367,370	149,553	130,646	8291	50,403	13,470
1991/92	4,075,352	33,456	18,603	–	9380	2493	244
1992/93	2,403,155	27,872	51,363	1065	–	490	–
1993/94	2,988,026	71,613	103,540	3736	41,069	800	87
1994/95	4,217,685	81,935	45,610	7733	55,299	3646	77
1995/96	4,522,935	95,659	30,754	5239	–	3336	–
1996/97	4,223,352	72,280	33,616	12,675	200	366	–
1997/98	4,244,662	77,777	27,342	14,835	–	–	–
1998/99	1,015,709	14,204	5054	2214	–	180	–
1999/00	3,906,193	64,277	50,651	11,240	11,679	175	–
2000/01	3,878,148	62,280	88,027	9469	31,256	903	–

Source: Dairy Development Enterprise (DDE).

Annex 4. Linkages between the introduction of market-oriented dairy production (MODP) and household impacts



Source: Ahmed et al. (forthcoming).