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1. Introduction

This report focuses on explaining the changing structure and prospects of the dairy sectors of the EU and of India, the two largest milk producers of the world. Key drivers will be taken into account, such as demographic and preference changes, incomes, prices, consumption patterns, as well as technological developments. Special attention is paid to the role of policies. Based on historical developments the approach of the report is forward looking.

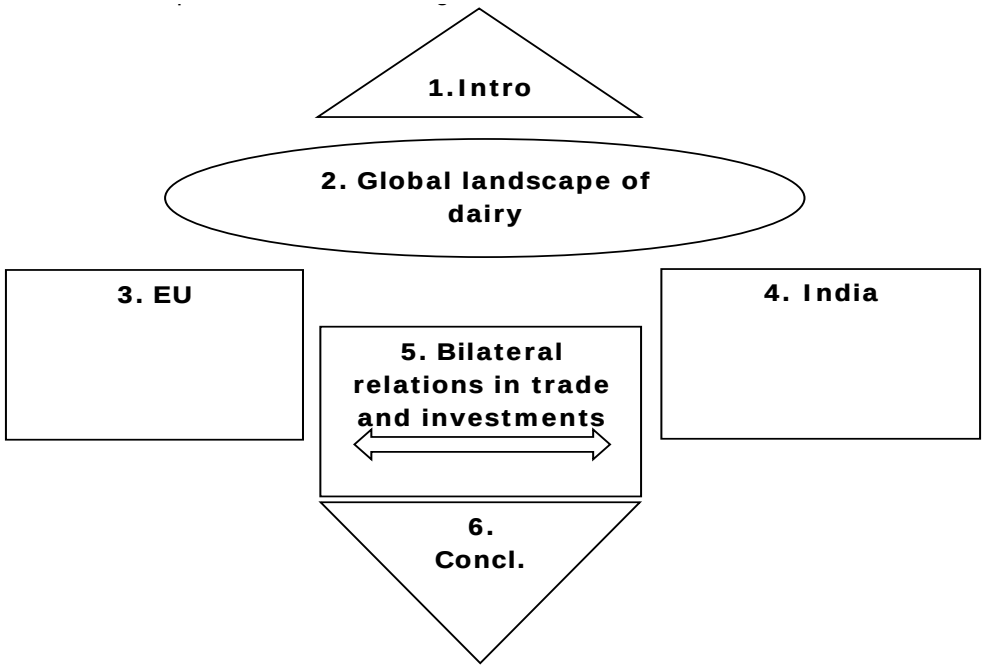


Figure 1.1 Structure of the report

The structure of the report is illustrated in Figure 1.1. To provide the context for the study, Chapter 2 addresses the changing global landscape of dairy. Trends in world milk production, processing and consumption are described, as well as developments in international trade, price formation and policies. The Chapters 3 and 4 provide a detailed account of structural developments in the EU and India. The conclusions of the report are presented in Chapter 5.

2. Changing global landscape of dairy

2.1 Introduction

The EU and India are the largest dairy producers and consumers of the world. Before analysing the structural developments in these regions, this chapter presents some important global trends in milk production, processing, consumption, prices and trade. It is based on public sources, especially on 'The world dairy situation 2010', published by IDF (Bulletin of the International Dairy Federation 446/2010). Also the recent OECD-FAO Agricultural Outlook 2011-2020 is a useful source of information.

2.2 Production of milk

World milk production of all species reached 703 million tonnes in 2009. Compared to 2008 it increased by 0.8%. This growth rate is small in comparison to the compound annual growth rate (+2.3%) observed during the period from 2000 to 2007 (Figure 2.1).

Cow milk production still represents 84% of the total world milk production. In many parts of the world cow milk production decreased in 2009. It even decreased in China, where the spectacular growth observed since 2000 was brought to a total standstill by the melamine crisis.

Buffalo milk production kept increasing in 2009. The world production of buffalo milk was estimated at 90 million tonnes in 2009. It constituted 13% of the total world milk production, compared to 8% in 1990. Buffalo milk is produced in few countries. More than 90% of the total volume is produced in India and Pakistan.

Goat milk constitutes around 2.2% of total milk production, sheep milk 1.3% and camel milk 0.2%. According to FAO data for 2009, goat milk was mainly produced in Asia (59% of world production), in Africa (21%) and in Europe (16%), whereas sheep milk production is largely located in Asia (46%) and Europe (34%), and camel milk mostly in Africa (89%).

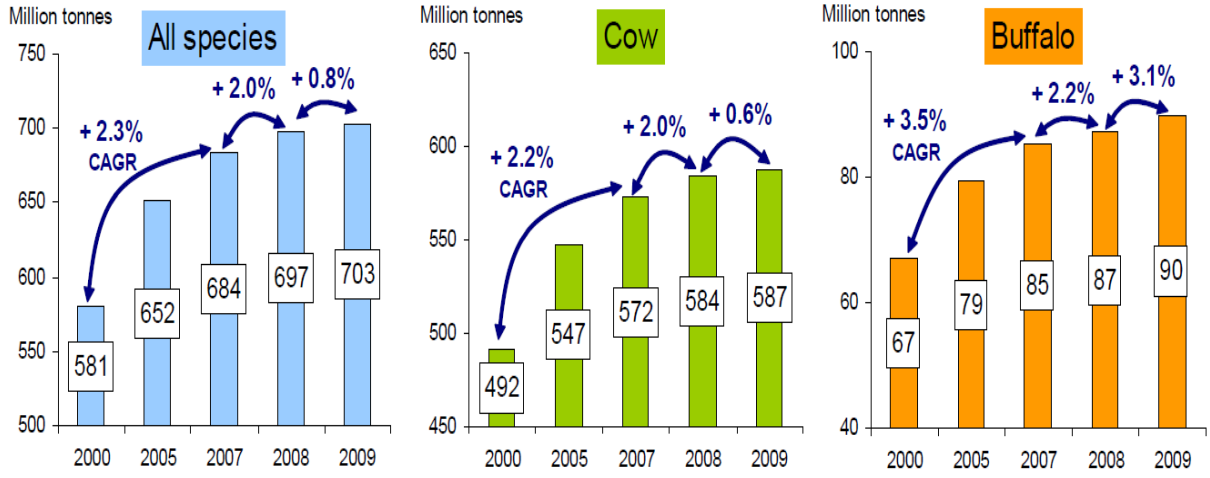


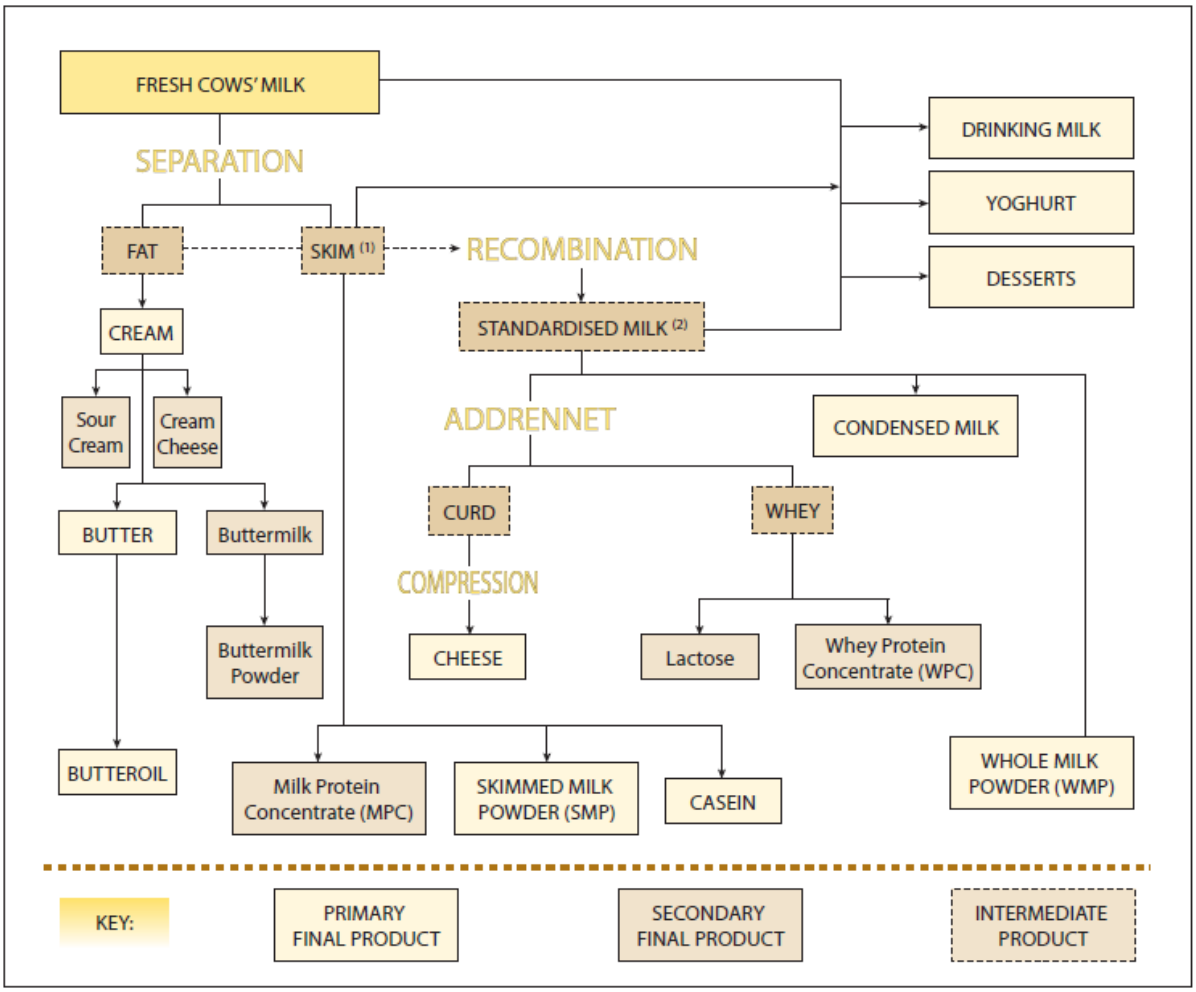
Figure 2.1 - Milk production growth between 2000 and 2009

CAGR: Compound annual growth rate

Source: IDF, 2010

2.3 Processing of milk

Milk is made up of fats (on average making up 4 % of the milk), proteins (3.2 %), other 'solids' (5.3 %) and water (87.5 %). It can be consumed as milk or converted by different processes (some traditional, some more modern) into a variety of dairy products and food ingredients (Figure 2.2).



Source: European Commission: Original Source: Trevor Smith - dairy industry consultant

(1) SKIM = protein + other solids (lactose + minerals) + water

(2) STANDARDISED MILK = of a fat content adjusted by the addition of skim or cream

Figure 2.2 - Products made from dairy cows' milk

In the USA and New Zealand almost 100% of cow milk production is delivered for processing. In other countries this share is much lower, but increasing (Table 2.1). In China for example, deliveries were higher in 2009, in spite of a decrease in cow milk production. The share of processed milk has been increasing regularly for the last few years in China, reaching 71% of produced milk in 2009, versus 60% in 2000. In Russia too, the share of delivered milk rose broadly during the last decade, from 39% in 2000 to 50% in 2009.

Table 2.1 - The share of processed milk in selected countries (2009)

Producer	Cow milk production (mln tonnes)	Milk deliveries (mln tonnes)	Share of deliveries (%)
EU 27	147.9	134.2	91
USA	85.9	85.4	99
China	35.2	25.0	71
Russia	32.6	16.3	50
Brazil	28.0	19.6	70
New Zealand	17.0	16.9	99

N.B. India not ranked (no reliable data)

Liquid milk and milk drinks

In recent years, liquid milk output has been rather stable in most western countries. In other parts of the world, it showed a sustained growth. The production of fermented products and milk drinks presented a more sustained growth than production of liquid milk in most countries of the world.

Butter and other milk fats

World output of butter and other milk fats (butteroil, ghee) is estimated at approximately 9.5 to 10 million tonnes. The recent increase mainly concerned ghee produced in India.

Cheese

World production of natural cheeses (i.e. all cheeses excluding processed cheeses) is estimated at around 20 million tonnes. The EU is by far the biggest producer. Cow's milk cheeses produced from milk delivered to dairies (i.e. industrial cheeses) represent more than 80% of the global natural cheese production. The rest is made up of farm and homemade products, but also cheeses made from other milk (sheep, goat, and buffalo). Europe and Northern America represent 80% of the world natural cheese production.

Milk powders

World production of WMP (Whole Milk Powder) is estimated at around 4 million tonnes. In Europe, production has been decreasing for the last ten years. World production of SMP (Skimmed Milk Powder) is estimated at around 4 million tonnes.

Other products

World production of condensed milk is estimated at around 4.7 million tonnes in 2009. In the 1980s, world production was dominated by the EU, the United States and the ex-USSR. Now it is much more scattered with significant contributions in the Far East and South America. The major processors of whey are located in Europe, North America and Oceania, which correspond to the major cheese production areas.

2.4 Dairy companies

Leaders in the dairy industry are multi-billion dollar companies (Table 2.2). On top of the list is Nestlé, followed by some companies in the mature markets of Europe and the US. But companies from Asia are moving up, such as Meji Dairies from Japan and Yili from China.

Most dairy companies experienced a decrease in turnover in 2009, primarily due to the sharp decrease in dairy product prices. However there were exceptions, especially in Asia and in America. Growth remained steady for the Asian companies. Turnover in 2009 increased by 8% for Mengniu and by 14% for Yili. In America, some companies boosted their activities through an ambitious purchasing strategy. Mexican Lala bought several companies in the United States: National Dairy Holdings (18 plants; annual sales of 1.8 billion USD), Promised Land and one Farmland Dairies plant. Lala's turnover (2.9 billion USD in 2008) might now approach 5 billion USD.

Table 2.2 - Main dairy companies in 2009 (dairy turnover in billion USD)

>20	10 to 20	6 to 10	4 to 6	3 to 4
Nestlé 27.3	Danone 16.0	Dean Foods 9.7	Saputo 5.2	Mengniu 3.8
	Lactalis 11.8	Fonterra 9.6	Meiji Dairies 5.1	Yili 3.6
	FrieslandCampina 11.4	Arla Foods 8.7	Parmalat 5.1	Sodiaal 3.5
		DFA 8.1	Morinaga 4.8	Land O' Lakes 3.2
		Kraft Foods 6.8	Bongrain 4.6	Bel 3.1
			Lala 4 to 5	Tine 3.0
				Schreiber 3 to 4

Source: IDF, 2010

Volume growth is taking place in regions like China, South East Asia and selected markets in the Middle East, Africa and Latin America. For the developed markets of Europe, the USA and New Zealand, the main growth challenge is to introduce new characteristics – often related to health and convenience - to standard dairy products that the consumer is willing to pay for. On the supply side, land availability and climate will prove a challenge for Asian and South American companies moving forward. Decisions on whether to rely on imported raw materials or on developing a fresh supply chain locally or elsewhere will all influence the global market balance.

Global consumer trends shaping the dairy industry

(Source: Tetra Pak Dairy Index, Issue 1 2009)

1. Economising

As the world economic crisis deepens, consumer confidence around the world is falling and people are increasingly concerned about losing their jobs and being able to pay their bills. According to recent consumer research by GfK Roper Consulting, the number three concern among consumers around the globe is having enough money to live well and pay their bills — with 31% of consumers worldwide mentioning this as a top concern. As a result, more and more people are economising. They're more willing to look around for the best offer, and they expect more value for their money. However, instead of cutting down on dairy products, consumers are now more likely to buy plain milk than fortified milk, choose budget brands over premium brands and buy their products through different channels, like discounters. For example, although Western European consumers buy most of their milk in supermarkets or hypermarkets, the percentage of milk sold either in discounters or other non-grocery retailers, such as convenience stores, has grown by 7.5% over the last three years. And this trend is expected to continue. Consumption of private label products in Western Europe now represents approximately 36% of total white milk consumption - as consumers look for more value for their money.

2. "Anxious consumers"

With the worldwide economic crisis, food-related health scares, terrorist attacks and disease epidemics regularly headlining the world news, a new consumer subculture is developing, which is both more alert to and more nervous about serious issues. This is called the "anxious consumer." According to a recent international poll, developing regions are particularly worried about food safety. More than 59% of consumers in developing countries said they worried about the safety of the food they buy, compared to 49% in developed countries. In addition, 51% of consumers in developing countries said they were concerned about whether refrigerated beverages had been properly stored before they bought them, compared to 31% expressing concern in developed countries. Anxious consumers around the world are helping to change the way food, and particularly milk, is consumed in their markets. More specifically, they are helping to drive conversion to packed milk, mainly UHT (Ultra High Temperature) milk. According to Tetra Pak data, worldwide consumption of UHT milk has increased from 18.7% of total liquid dairy products sold in 2004 to 23% in 2008 — a compound annual growth rate of 7.9%.

3. Stretched lives

All around the world, people are becoming busier and busier, both with work and social activities. Today's consumers value their time and increasingly expect to be able to do the same things they once did at home no matter where they are — from watching TV to checking emails to eating and drinking. To these consumers, home is no longer a location; home is wherever they happen to be. Busy, mobile consumers seek ready-to-drink products. Currently 20% of consumers worldwide sip a drink while walking or driving at least once a week. In addition, active households have less time for cooking so they are looking for products that are convenient, easy to use and easy to prepare. This can mean, for example, switching from flavoured milk powder or baby formula in powdered form to liquid milk products. It can also mean favouring drinking yogurt over eating yogurt with a spoon. From 2005 to 2009, consumption of flavoured milk sold in ready-to-drink liquid form has increased by a compound annual growth rate of 9.6%. This compares to an annual increase of 1.9% over the same time period for flavoured milk powder. During the same time period, consumption of yogurt drinks has risen by a compound annual growth rate of 9% compared to 4.5% for spoonable yogurt.

4. Health and wellbeing

Good health ranks number 1 in 24 out of 25 countries as the core component of a "good life." In fact, all around the world, health is quickly becoming a consumer priority. While developing markets worry about the safe, hygienic, production of food, mature markets are more focused on issues such as obesity and nutrition. However, that doesn't mean these concerns are always translated into action. This health and wellness trend has had a big impact on the dairy market as different healthy segments emerge to satisfy different needs. For example, fortified and functional milk is the fastest growing segment among products that target health-conscious consumers, with global sales now topping US$20 billion annually. Over the period 2005-2009, sales of fortified/functional milk in Western Europe alone have grown by 12.5%. At the same time, consumption of soy milk is increasing because soy protein has been linked to benefits such as reducing cholesterol, improving bone health and aiding relaxation.

5. Simple and authentic

Some consumers are demonstrating resistance to what they perceive as over-marketing in today's world. These consumers prefer "real" or traditional products, traditional craftsmanship and traditional experiences, rather than "fake," "spun" or "over-marketed" ones. About 600 million global consumers value simplicity, which is roughly defined as "keeping your life and mind as uncluttered as possible." When it comes to food, traditional products are what global consumers want most. Around 68% of global consumers say they tend to stick with foods with which they are familiar. Approximately 57% say they try to avoid "ready meals" at home, and the same percentage say they try to avoid eating fast food. This trend toward simplicity and authenticity is expected to become increasingly important, particularly in developed markets. In these markets, consumers are expected to show a return to traditional values and production methods, which will impact the types of dairy products they buy and consume, especially when coupled with today's challenging economic situation.

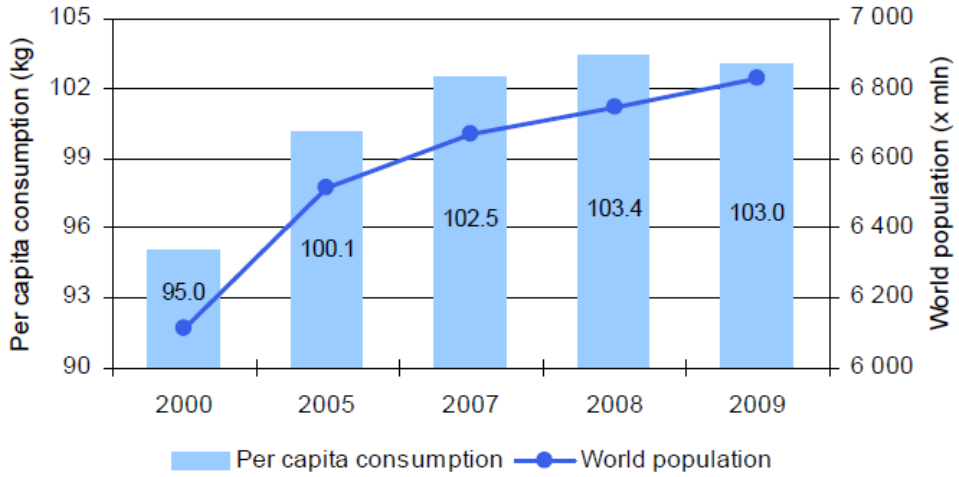
6. Ethical choice

All around the world, consumers agree that the environment is important. In fact, 54% of global consumers rate preserving the environment as extremely or very important as a guiding principle in their lives. However, when it comes to taking the lead on climate change, consumers feel that it's up to big organisations, not themselves, to assume the primary responsibility. And while consumers demand more ethical products — from organic goods to fair trade foods to products

available in environmentally friendly packaging, they're generally not willing to compromise their priorities for it. They may say they desire to act ethically and environmentally, but whether they will buy and behave more ethically moving forward is uncertain, especially in turbulent economic times. Those that have to be more careful with their money may push back when money gets tighter. Furthermore, consumers may begin to take "ethical" for granted and expect ethical products to be available at the same price and quality as the "less ethical" ones.

2.5 Consumption

Apart from public and private stock changes, global consumption equals world milk production. This consumption includes human consumption, but also the use of milk for feed purposes and for some technical applications (both food and non-food). Compared to the year 2000, total volume has grown with 122 million tonnes (+21%). With an estimated population amounting to 6.83 billion people, global per capita consumption of milk in 2009 was 103.0 kg (Figure 2.3). Between 2000 and 2009 global per capita milk consumption has grown by 8% (+ 8.0 kg). This average conceals huge regional differences between for example countries in Europe, which is a traditional dairy region, and upcoming dairy countries in Asia.



Source: Calculation based on world milk production figures and UN population forecasts

Figure 2.3 - Per capita milk consumption versus development in world population

Asia is the most important consuming region, followed by Europe and North America (Table 2.3). Asia, Africa and Central America (including Mexico) are examples of regions with relatively high net dairy imports. The EU is a relatively large net exporter. Oceania however is the only region in the world, where consumption is lower than net exports volume. About 60% of production (based on FAO figures) is exported outside Oceania, which results in a self-sufficiency rate of close to 250%.

Table 2.3 - Global milk consumption by region (2009)

Producer	Consumption (mln tonnes)	Share (%) world consumption	Share (%) of world production
Asia	268.3	38.4	36.0
Europe	206.8	29.6	30.8
EU 27	*145.8*	*20.8*	*22.0*
Non-EU	*61.0*	*8.7*	*8.8*
North America	93.0	13.3	13.4
South America	58.3	8.3	8.5
Africa	42.6	6.1	5.2
Central America	19.7	2.8	2.3
Oceania	10.6	1.5	3.7
World	699.5	100	100

Source: Calculation of consumption volumes based on FAO Food Outlook June 2010

2.6 Trade

Improved refrigeration and transportation technologies have made dairy trade more practicable than in earlier years, though high costs are still a constraint. Almost every country produces milk for local consumption, but production costs vary substantially due to such factors as labour costs, animal productivity, on-farm technology, and the availability of forages and water for livestock. Countries with a dairy surplus tend to be those with relatively abundant, low-cost milk inputs for milk production and comparatively small populations, such as New Zealand. Japan, Norway, and Switzerland are high-cost milk-producing countries largely due to their lack of land for growing dairy feeds. Canada and the EU lie between the two cost extremes, as does the USA (USDA: U.S. Dairy at a Global Crossroads / ERR-28).

In 2009, world dairy trade (A), which excludes the EU-intra trade(B) volume, amounted to about 49.8 million tonnes milk equivalents (C). This was nearly 7% above the level in 2008

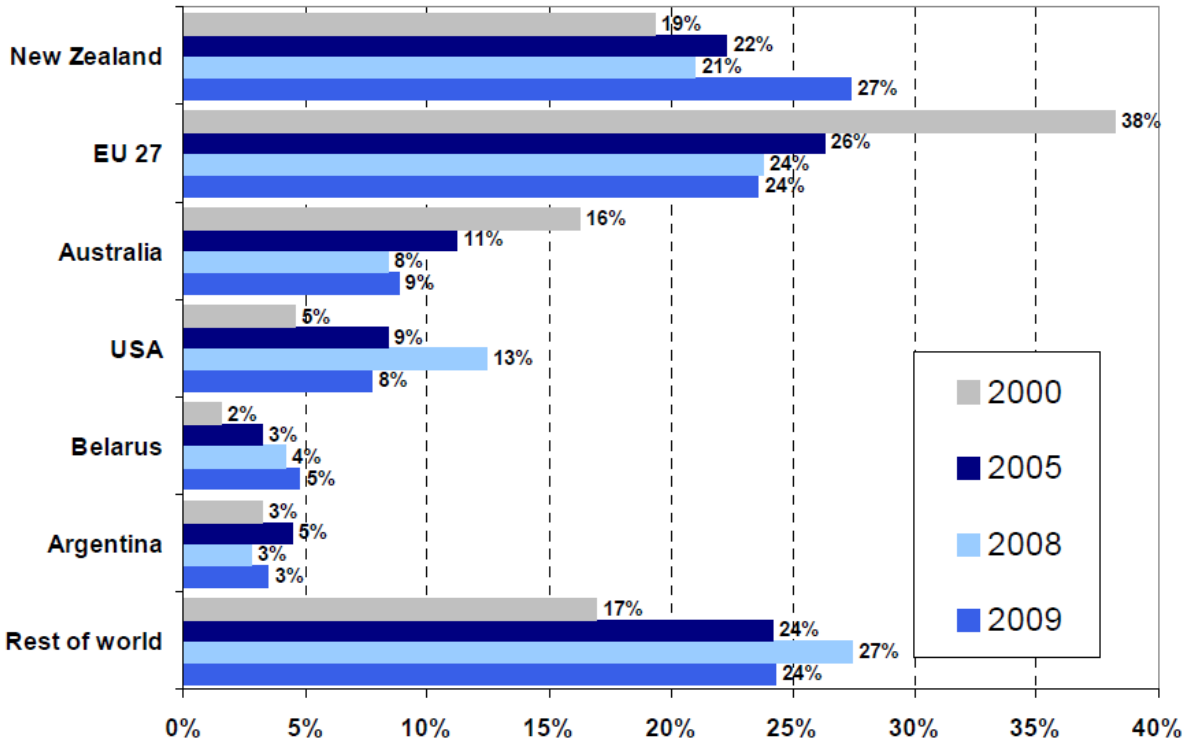
(A) World dairy trade is defined here as the global export volume minus the EU-27 intra-trade volume: volumes are based on total trade flows of the following commodities: butter and butter oil, SMP, WMP, condensed milk and cheese.

(B) EU is defined as the EU-27 territory. In 2009, the volume of EU intra-trade of said commodities amounted to 34.8 million tonnes (or 41% of total global trade volume).

(C) Conversions of product volumes into milk equivalents are based on the non-fat solid content methodology.

(D) As part of total world trade volume, reference volumes (million tonnes) used: 2000: 38.8 / 2005: 43.9 / 2008: 46.8 / 2009: 49.8.

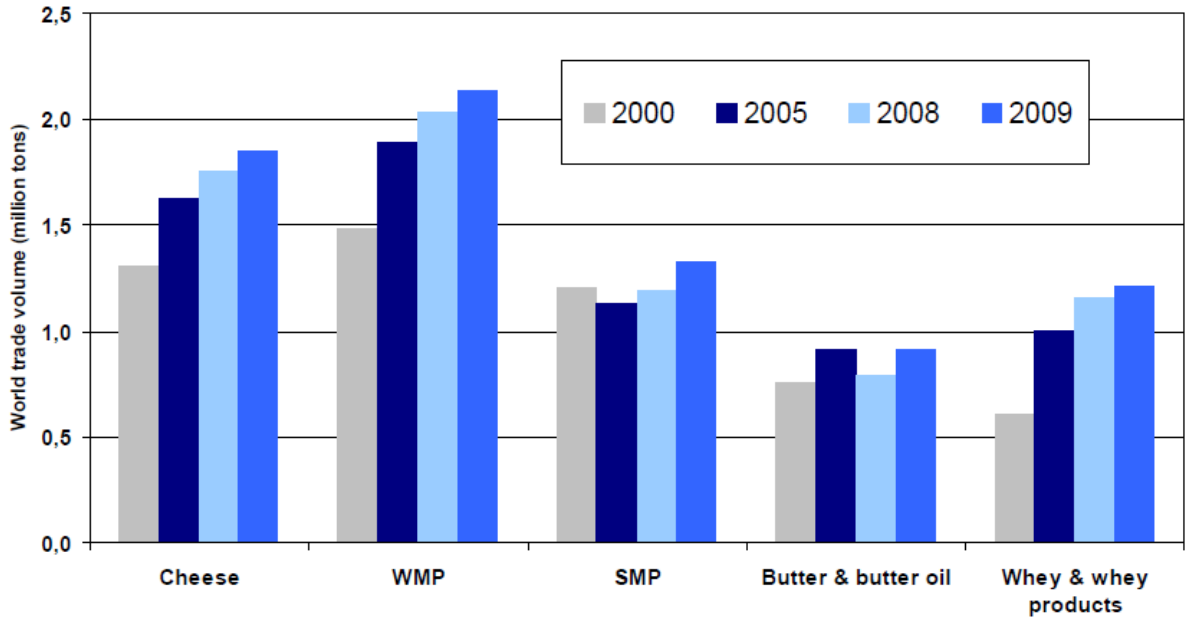
In 2009 New Zealand resumed its leading position as prime supplier to the world dairy market, attaining a 27% share of world dairy trade (Figure 2.4). Furthermore, EU and Australia also expanded their overall export volumes, though on a more modest level. In the case of EU, trade in SMP and, to a lesser extent, cheese was primarily responsible for this increase.



Source: PZ, Comtrade

Figure 2.4 - Export share development of key exporters on the world dairy market (milk equivalent basis, period 2000-2009)

Since 2000, world trade volume, with ups and a few downs, has grown by 3% per year. Thus, trade has increased more than production, which over the same period stepped up by around 2% per year. The development of trade volume per product category is shown in Figure 2.5. In 2009, the overall share of world dairy trade in the global milk pool was just over 7%, which is quite modest compared with shares of other farm commodities, such as wheat, coffee, soybeans, or bananas at 30 to 40 per cent. This puts into perspective the role of international trade and underlines the fact that the main focus in dairy is still local, at most regional.



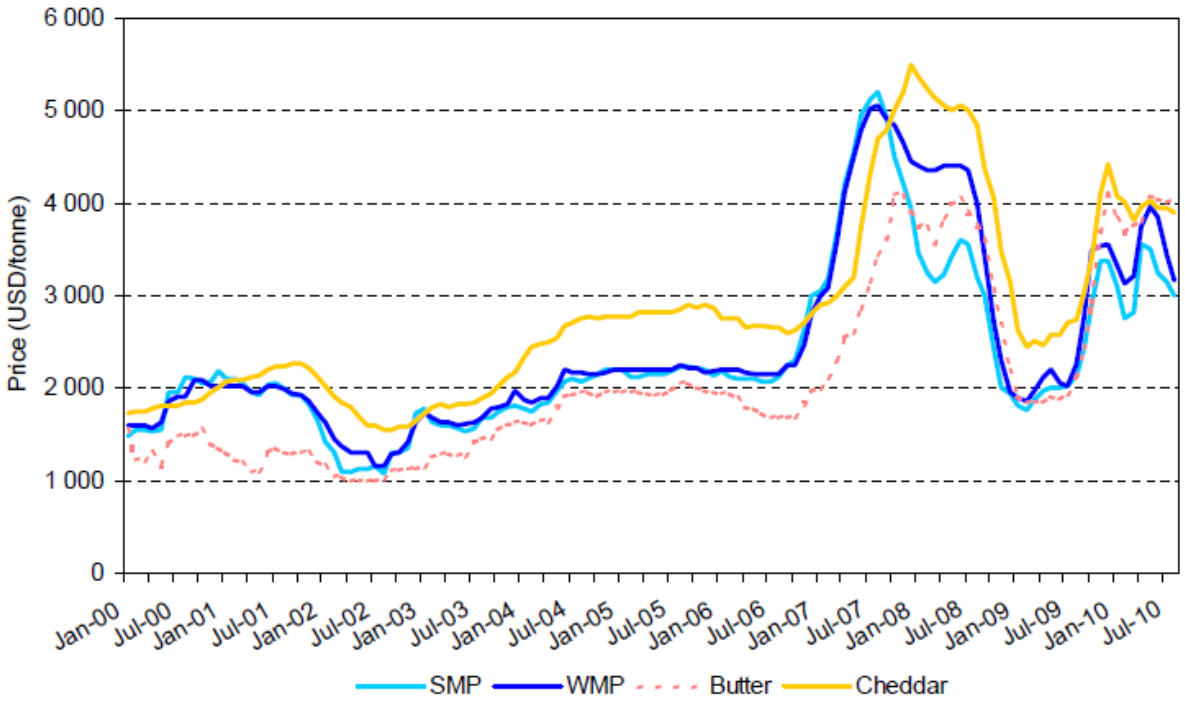
Source: PZ, Comtrade

Figure 2.5 - World dairy trade: volume development by product category

2.7 Prices and policies

In late 2008 international demand for dairy products started to decline caused by the financial and credit crisis in the world economy. This had a dramatic impact on product prices during the first half of the year 2009 (Figure 2.6). Reduced demand in the EU and collapsing world market prices had a direct effect on EU market prices. In the EU, a further decline in prices and a growing uncertainty in the market were encountered by domestic and export support measures from the European Commission. Also in the USA the DEIP (Dairy Export Incentive Program) was reactivated and from May the first export refunds were allocated. In the context of the rapid fall in international prices, private and public stocks of dairy products increased. The support measures thus reassured the market and prevented prices from further collapsing.

The strong recovery in prices was triggered by increased demand, mainly from oil exporting countries, but also from China. Moreover, the price strengthening also took place as a result of reduced supplies available in some regions (milk supply from the Southern Hemisphere was limited). Chinese imports of dairy products have soared during the latter half of 2009. This was partly attributed to the melamine scandal in China with consumers turning away from local produce, but also because prices were so much lower than in the previous year. Chinese WMP demand has been a key driver of rising dairy commodity prices. On international markets all dairy product prices were showing signs of recovery.



Source: USDA (Oceania export prices)

Figure 2.6 - World market price development (F.O.B. port, USD per tonne)

After rebounding in 2009, international dairy prices remained at relatively high but stable levels over much of 2010. Toward the end of the year and early 2011, global prices strengthened rapidly but stayed well below the peak levels of 2007/08 with the exception of record high butter prices (Oceania). Much of the strength in the dairy markets could have been attributed to a combination of strong demand in the Russian Federation and South East Asia, and constrained supplies from Oceania. Imports of milk powders to China have soared, fuelled by rising income but also food safety concerns, in the aftermath of the milk adulteration incidents.

Steep increases in grain and energy prices have put upward pressure on feed costs, curtailed supply expansion and have been additional factors underpinning prices. The global dairy sector is entering into a decade of relatively high prices, continuing strong demand for milk and dairy products but also higher production costs and possibly continued market variability (OECD/FAO, 2011).

2.8 Outlook

According to FAO and OECD, milk production will increase during the next years by 2.1% annually (Table 2.4). This rate is expected to be lower among OECD members than in the rest of the world.

Table 2.4 - Outlook for milk production in the world and in selected countries (million tonnes)

	2009	2010	2011	2012	2013	2014	2015	CAGR (%)
World	683.2	694.1	711.1	727.6	743.4	758.9	774.7	2.1
OECD	309.2	308.9	312.8	315.3	317.7	320.0	322.9	0.7
Non-OECD	374.0	385.2	398.4	412.3	425.7	438.9	451.8	3.2
Developed	358.0	357.9	363.1	367.5	371.4	375.4	379.9	1.0
Developing	325.2	336.2	348.0	360.1	371.9	383.5	394.8	3.3
LDCs	24.3	25.3	25.9	26.8	27.7	28.6	29.4	3.2
European Union-27	147.0	146.5	147.6	148.3	148.5	148.8	149.8	0.3

India	108.8	112.1	115.9	120.0	124.0	127.8	131.6	3.2
United States	85.8	85.4	87.0	87.7	88.7	89.6	90.6	0.9
Australia	9.7	9.2	9.3	9.6	9.8	10.0	10.1	0.7
New Zealand	16.7	17.1	17.6	17.9	18.1	18.4	18.6	1.8
Russia	32.4	33.1	33.9	35.0	35.6	36.1	36.5	2.0
Brazil	28.6	29.5	30.3	31.1	31.9	32.6	33.3	2.6
China	33.3	36.7	39.6	42.0	44.1	46.2	48.4	6.4

Source: calculations based on OECD-FAO, Agricultural Outlook 2010

The share of non-OECD members in global production is expected to be higher in 2019 than today for all milk products. The output of OECD members will remain dominant in global production only for cheese and skim milk powder (Table 2.5).

Table 2.5 - Production of dairy products in OECD and non-OECD members

	Average 2007-2009			Forecast 2019		
	World (billion tonnes)	OECD (%)	Non-OECD (%)	World (billion tonnes)	OECD (%)	Non-OECD (%)
Butter	9.7	39	61	12.4	32	68
Cheese	19.4	77	23	23.2	73	27
SMP	3.4	77	23	3.7	70	30
WMP	4.3	47	53	5.6	40	60

Source: OECD-FAO Agricultural Outlook 2010-2019

As for consumption, in 2019 non-OECD members will play a dominant part for butter and milk powders, especially whole milk powder. But OECD members will remain the main area for cheese consumption (Table 2.6).

Table 2.6 - Consumption of dairy products in OECD and Non-OECD members

	Average 2007-2009			Forecast 2019		
	World (billion tonnes)	OECD (%)	Non-OECD (%)	World (billion tonnes)	OECD (%)	Non-OECD (%)
Butter	9.7	33	67	12.3	27	73
Cheese	19.3	74	26	23.1	71	29
SMP	3.2	53	47	3.7	49	51
WMP	4.2	20	80	5.5	17	83

Source: OECD-FAO Agricultural Outlook 2010-2019

According to FAPRI's agricultural outlook, milk production will globally increase by 2.1% annually during the next decade. Milk production is expected to increase strongly in India (+3.4%) and China (+7.6%), whereas it will decrease slightly in Canada (-0.2%) and in Japan (-0.5%).

As for dairy products, the biggest increase in global production during the next decade is for butter (+2.9% annually). India is already by far the biggest butter producer. Driven by rapidly growing domestic demand, Indian butter production will increase by 5% annually and will account for 90% of global growth.

Cheese is the only product for which the EU output will not decrease during the next decade. The EU and the USA will remain the two main cheese producers in the world in 2019, accounting for more than half of global production.

Butter	2009	2019	CAGR 09/'19 (%)
India	3 855	6 270	5.0
EU 27	2 090	1 967	-0.6
United States	708	757	0.7
New Zealand	419	483	1.4
Russia	280	298	0.6

Cheese	2009	2019	CAGR 09/'19 (%)
EU 27	6 730	7 544	1.1
United States	4 583	5 279	1.4
Brazil	614	947	4.4
Argentina	534	699	2.7
Egypt	441	615	3.4

SMP	2009	2019	CAGR 09/'19 (%)
EU 27	1 080	916	-1.6
United States	778	870	1.1
India	364	590	4.9
New Zealand	316	395	2.3
Australia	219	265	1.9

WMP	2009	2019	CAGR 09/'19 (%)
China	977	1 700	5.7
New Zealand	781	825	0.5
Brazil	473	816	5.6
EU 27	790	588	-2.9
Argentina	222	315	3.6

Source: FAPRI 2010 World Agricultural Outlook

Figure 2.7 - Main producers of butter, cheese and milk powder in 2019

2.9 Concluding remarks

This chapter has shown that the global landscape of dairy is changing in several ways:

- Production of milk of all species is increasing, reaching more than 700 million tonnes in 2009. Cow milk remains dominant (84% in 2009), but the share of buffalo milk has risen to 13%. In the next decade milk production will increase by 2.1% annually. This rate is expected to be lower among OECD members than in the rest of the world.
- Processing of milk is rising faster than the production of milk. In some countries (USA, New Zealand) almost all milk produced is already delivered for processing.
- The dairy industry is increasingly dominated by multi-billion dollar companies, which are active in many countries. Building on economies of size, they focus on different consumer trends: Economising, "Anxious consumers", Stretched lives, Health and wellbeing, Simple and authentic, Ethical choice.
- Dairy consumption is growing faster than population. Since the year 2000, annual milk consumption per capita has gone up by 8 kg to 103 kg in 2009.
- The share of global milk production entering world trade is low (7 percent). The main focus in dairy remains local, at most regional production and distribution.
- Cheese is the only product for which the EU output will not decrease during the next decade. The EU and the USA will remain the two main cheese producers in the world in 2019, accounting for more than half of global production.
- Butter is expected to show the biggest increase in global dairy production. India is already by far the biggest butter producer. Indian butter production is expected to increase by 5% annually and will account for 90% of global growth.

3. Dairy developments in the EU

3.1 Introduction

The EU is the largest milk producer of the world, with 148 million tonnes of milk accounting for 21% of world production in 2009. With the quota system introduced in 1984, the EU has effectively stabilised milk production of the Member States. Whereas global production has been increasing steadily, the share of the EU has declined. This chapter discusses the structural changes in the EU dairy sector. Special attention will be given to production (Section 3.2), processing (Section 3.3), dairy companies (Section 3.4), consumption (Section 3.5) and trade (Section 3.6). Section 3.7 discusses the evolution of EU dairy policies since the 1960s. The chapter is concluded in Section 3.8 with an outlook towards 2020.

3.2 Production of milk

Milk production represents a significant proportion of the value of EU agricultural output. The share of milk in total value of agricultural production varies between Member States, from 5.8 % to 33.5 %. The share tends to be higher in northern Europe and below 10 % in Mediterranean countries. There are two major producers, France and Germany, which together account for about 40% of the EU milk deliveries. Italy, the Netherlands and the UK follow at half of the output of the first two mentioned. Austria, Denmark, Finland, Ireland Portugal, Spain and Sweden are modest producers, followed by the other countries, with the exception of Poland. Poland has become a relatively important producer. Since the middle of the 1980s the production volume has been regulated by milkquota per Member State, with the present total just below 150 million tonnes (Figure 3.1).

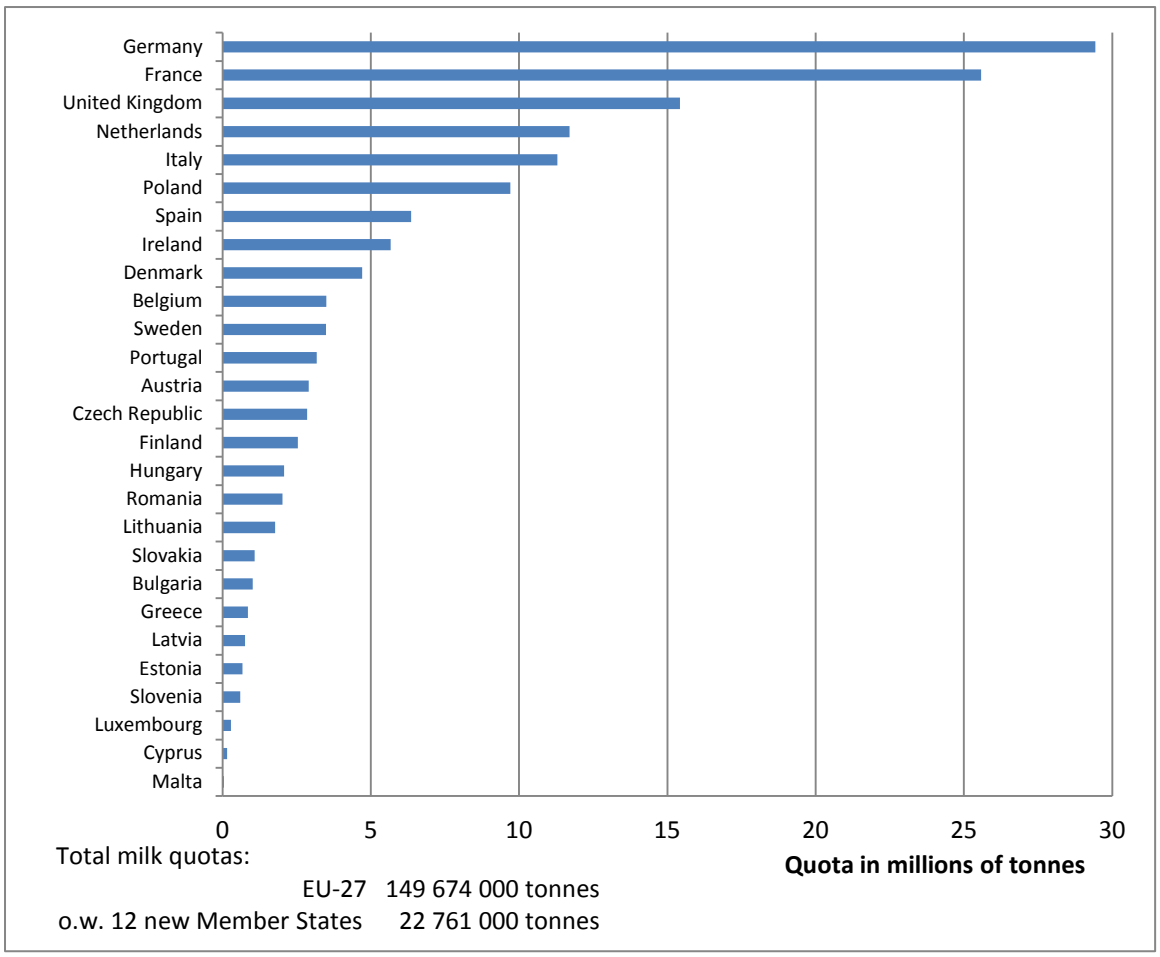


Figure 3.1 - Milk quota in EU-27 Member States (2010/11)

Dairy farming is structured differently from Member State to Member State. Farm and dairy herd sizes vary enormously, as do yields (particularly following the May 2004 EU enlargement that brought ten new Member States into the EU). However, as the dairy sector develops throughout the EU, so variations in yield and other technical factors are being reduced – less developed dairy producers are rapidly catching up with those who had restructured and modernised first. There is no 'typical' European dairy cow breed, though the Friesian-Holstein is the most prevalent.

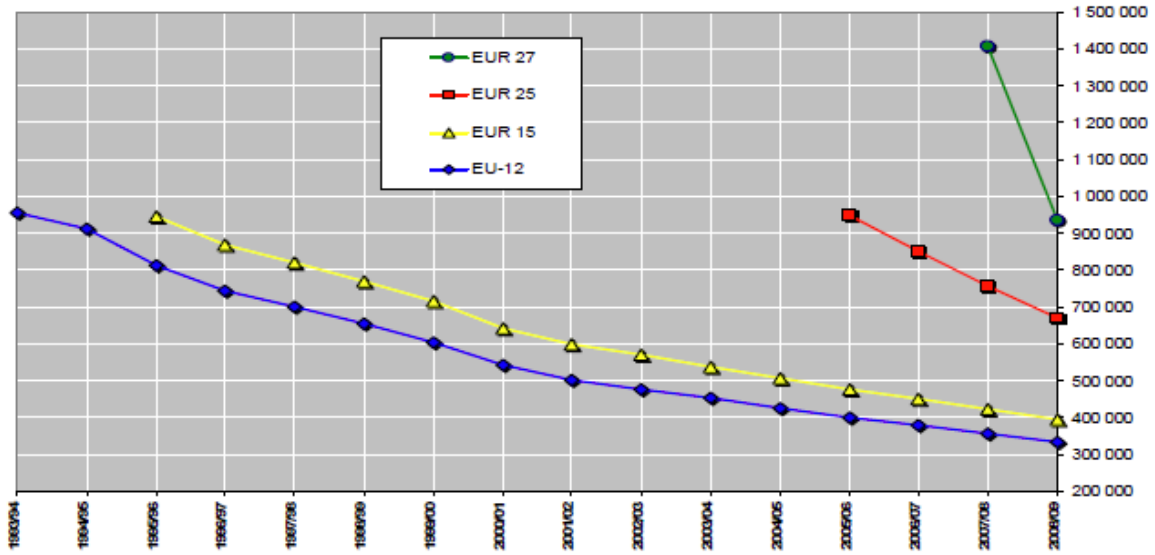


Figure 3.2 – Declining number of milk producers in the EU
Source: European Commission, 2010.
EU-12: Old Member States (excluding Austria, Sweden and Finland)
EU-15: Old member States
EU-25: Old and New Member States (since 2004)
EU-27: All Member States (since 2007)

In the old (EU-15) and the New Member States (EU-10 plus EU-2) farm numbers are declining (Figure 3.2), and this trend is forecasted to continue (Nowicki et al., 2007). The numbers of total farm units per Member State (MS) reflect a general trend to increase farm scale and to exploit the economies of scale (and reduce per unit costs of production). This trend also applies to the dairy sector. As far as milk output is effectively constrained by the quota, and the yields of dairy cows show a steady increase, less and less cows are needed to fill the quota (Table 3.1). This not only leads to a substantial decline in the number of dairy cows, but is also an additional factor influencing structural adjustment.

Table 3.1 Evolution of the number of dairy cows in the EU, 1990-2010 (thousands)

	EU-15	EU-10	EU-27
*1990	26,138		
2000	19,910	5,055	26,947
2001	20,002	4,949	26,929
2002	19,551	4,905	26,441
2003	19,257	4,707	25,922
2004	18,732	4,570	25,237
2005	18,375	4,544	24,891
2006	17,974	4,342	24,305
2007	17,900	4,367	24,176
2008	18,088	4,343	24,229
2009	17,807	4,161	23,682
2010	17,588	4,061	23,132

Notes: *Austria 1991, Finland 1991 (growth rates are corrected). Figure for Sweden is an estimate, based on the average change (1990-2000) for EU-15 without Sweden

Source: Eurostat.

There is an additional decline; the share of farms specialising in milk production decreases compared to mixed farming. This holds for the EU-15, with the exception of Germany and Portugal. In some MS this decline is relatively minor (Belgium, France, Netherlands), in others it is more pronounced (Austria, Denmark, Spain, Finland, Ireland, Luxembourg), and in a few it is quite significant (Sweden, UK). This might reflect a strong structural change taking place in dairy (scale increase). In parts of the New MS, there is indication of restructuring, with an increase in the share of dairy farms in Latvia and Lithuania that is in contrast to the steady decline in Estonia, Poland, Slovenia, Slovakia. For the EU-2, one sees the positive effects of restructuring (i.e. increase in farm size and specializing production systems) in view of accession to the EU.

A variety of systems is in operation for marketing the milk produced on dairy farms. Most dairy farmers sell their milk to dairy processors and it then enters the food chain. Other dairy farmers market their milk directly to consumers and on some dairy farms milk is consumed on the farm. In some of the new Member States (in Eastern Europe) a significant proportion is still consumed on farm. Ownership of dairy plants varies across the MS. In some farmer-owned cooperatives dominate processing of milk, while in others private companies take up the highest share. Distinct 'national' markets were once the norm – now there is more cross-border ownership of farms and processing facilities.

The costs of production of milk vary significantly over Member States. Non-specific costs include those associated with machinery, building upkeep, energy (fuel, electricity), contract work, taxes (excluding milk superlevy) and other direct inputs (including water and insurance on farm buildings). They have a relatively 'fixed' character and are not likely to have been affected by any of the considered policy changes. The average non-specific costs varied between 58 and 78 euro per tonne for the period observed. Member States having relatively low non-specific costs are Greece, Spain, Bulgaria, Portugal and Poland (the average in period 2000-2007 was €40 or less). Member States with relatively high non-specific costs are The Netherlands, Austria, Germany, Czech Republic, Sweden, France, Slovakia and Finland (the average in period 2000-2007 was €80/t or higher). Non-specific costs show a tendency to increase over this time. Together the specific and non-specific costs represent the total operational costs. Depreciation is also a relatively exogenous cost item.

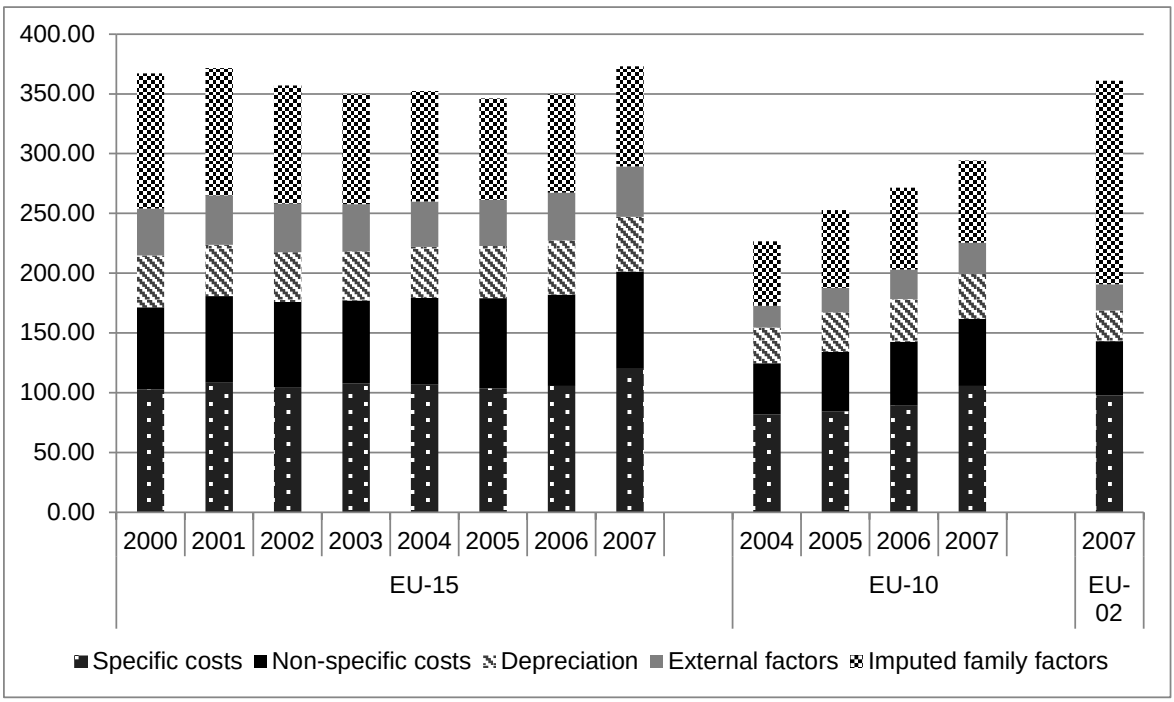


Figure 3.3 Decomposition of costs of milk production in the EU (€/t)
Source: EU-FADN.

The costs associated with external factors for the EU-15 were on average €40/t, while in the EU-10 and EU-02 it was about half as large (Figure 3.3). The higher costs in the EU-15 are related to a relative increase in dependence on external factors, which is related to its large farm scale. Of the costs associated with the primary production, labour is an important item worthwhile to be considered further. Getting accurate estimates of the opportunity costs is not trivial, but is important for comparing full costs over Member States. The estimates used in this study are calculated according to the methodology employed by the European Commission. The imputed family factor costs (family owned capital and family labour) in the EU-15 for the average dairy farm significantly declined over the period 2000-2007 (-26%), decreasing from €113.1/t to €83.9/t (the annual decline is €4.37/tonne). This is related to the increase in farm scale. In contrast, the imputed family costs in the EU-10 over the period 2004-2007 increased by 28%, from €53.9/t to €68.7/t (an annual increase of €4.82/t). The level of imputed family factor costs per unit of milk in EU-15 and EU-10 quickly converge over time.

3.3 Processing of milk

In the EU more than 90% of cow milk production is delivered for processing. The annual amount of milk deliveries in the EU is rather stable (Figure 3.4). Whereas protein content of milk is rather constant and uniform throughout the EU, this does not hold for fat. The fat content in the EU-15 is about 2% higher than in the EU-12. The countries with an increase in fat content over the period 2001-2010 are Austria, Finland, Greece, Italy, Latvia, Malta, Sweden and the UK, while it decreased in Czech Republic, Estonia, France, Germany, Hungary and Slovenia.

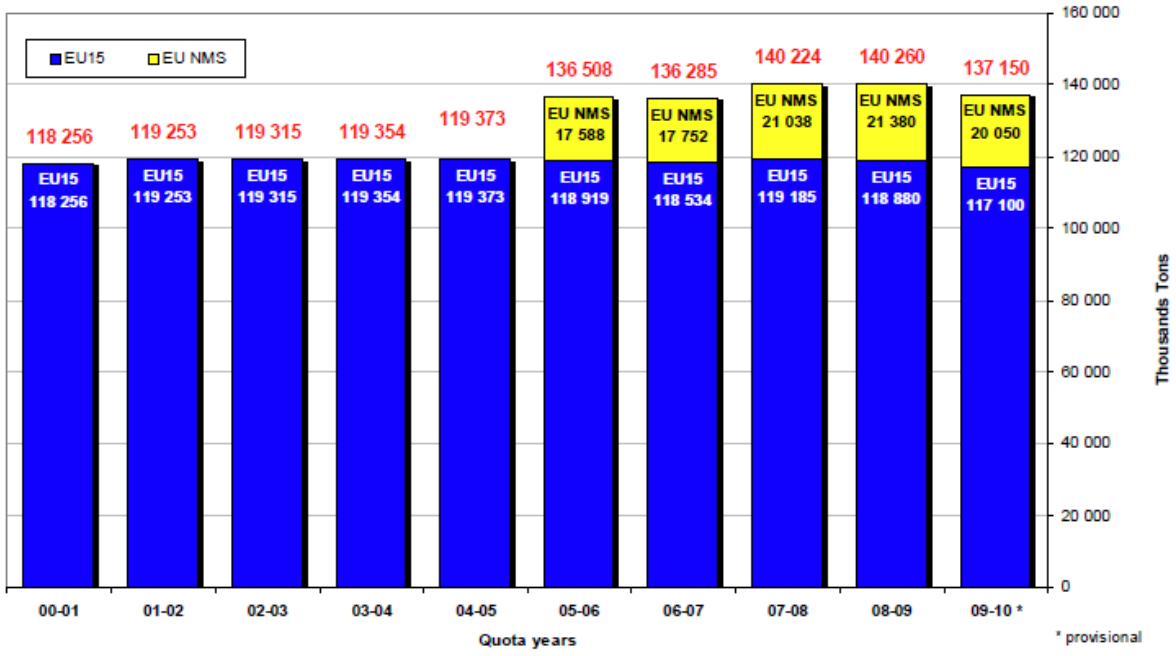


Figure 3.4 - Milk deliveries in the EU

Table 3.2 – EU production of drinking milk, butter, SMP, WMP and cheese, 2001-2009

		2001	2002	2003	2004	2005	2006	2007	2008	2009
Drinking milk	EU-15	29,620.4	29,483.9	29,527.7	29,467.1	29,317.4	29,314.9	29,353.3		
	EU-10	3,782.1	3,900.5	3,877.2	4,030.1	4,236.9	4,211.8	4,326.2		
	EU-02			157.0	188.0	206.0	246.9	235.9		
Butter	EU-15	1,360.1	1,412.4	1,414.6	1,296.5	1,158.8	1,173.4	1,169.3	1,316.5	1,063.9
	EU-10	32.3	99.0	91.6	190.1	195.0	184.6	190.5	141.9	181.6
	EU-02			6.1	7.4	1.1	9.0	10.3	10.5	11.6
Skimmed milk powder	EU-15	870.9	1,016.4	976.1	753.9	766.9	693.9	657.1	656.5	749.1
	EU-10	8.1	82.0	92.5	196.6	195.9	166.3	169.6	142.9	147.7
	EU-02			4.6	6.3	3.6	3.2	3.6	2.5	2.0
Whole milk powder	EU-15	497.7	479.7	461.7	458.3	487.3	445.3	405.2	461.4	388.4
	EU-10	15.2	33.8	39.8	67.2	65.4	55.4	51.5	57.5	43.2
	EU-02			2.4	2.4		2.4		0.1	1.8
Cheese	EU-15	6,982.4	6,980.9	7,073.5	7,187.4	7,227.5	7,362.2	7,372.1	7,352.8	6,417.9
	EU-10	748.8	951.2	926.0	898.6	953.9	1,019.9	997.4	1,029.3	1,046.9
	EU-02			129.6	141.1	151.4	157.5	146.3	143.3	141.8

Note: includes direct sales of licensed farms
Source: ZMP, using national statistics; EUROSTAT

EU-15 production and consumption of drinking milk are rather stable. In the New Member States (EU-10 and EU-2), however, production and consumption have grown. The proportion of output of butter to that of drinking milk varies across MS. Production of SMP is declining over time. This most likely reflects the shift in product mix, with the production of cheese expanding relative to that of butter and SMP. WMP production tends to decline, although production quantities fluctuate over years. This also reflects the relative increase in demand for high value added products (e.g. cheeses).

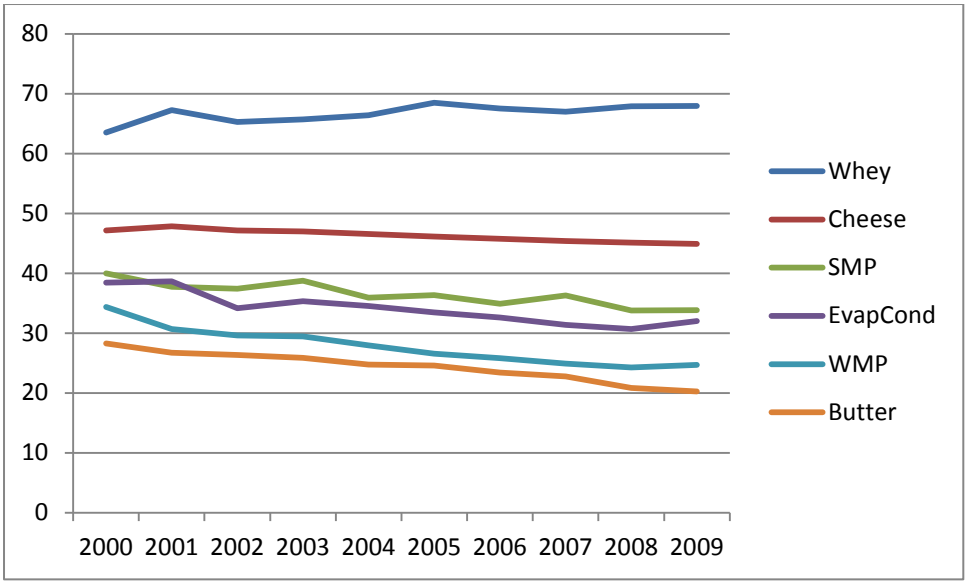


Figure 3.5 EU production of dairy products as a share of world production (per cent), 2000-2009

The EU maintains high but gradually falling shares in the world production of processed dairy products (Figure 3.5). For the most valuable product category of cheese, the share of the EU was still around 45% in 2009.

3.4 Dairy companies

The dairy industry represents roughly 15 % of the turnover of the food and drinks industry in Europe (employing about 13 % of the total workforce).

There are currently around 5000 dairy processors in the EU, of which about 55% is categorized as being small-sized (volume of raw milk processed less or equal to 5,000 t) processors, 26% as medium-sized (volume of raw milk processed between 5,001 and 100,000 t), and 18% as large sized (volume of raw milk processed, 100,001 t or more) (European Commission, 2009). The degree of concentration shows a clear tendency to increase over time, indicating a continuous process of change towards consolidation. In 2006 the total number of dairy processors was about 5800 in the EU 27. Except for Portugal, The Netherlands and Sweden, for all other EU-15 member states the number of dairy processors declines over time (for the UK even by more than 5% per annum, and with lower rates of decline for other EU-15 Member States). As regards the EU-12 the picture is more dispersed. Estonia, Latvia and Slovakia show an increase in the number of dairies in the period 2003-2006. In Czech Republic, Hungary, Lithuania and Slovenia significant declines in the number of dairies are observed (notably a decrease by 58% per annum for Slovenia).

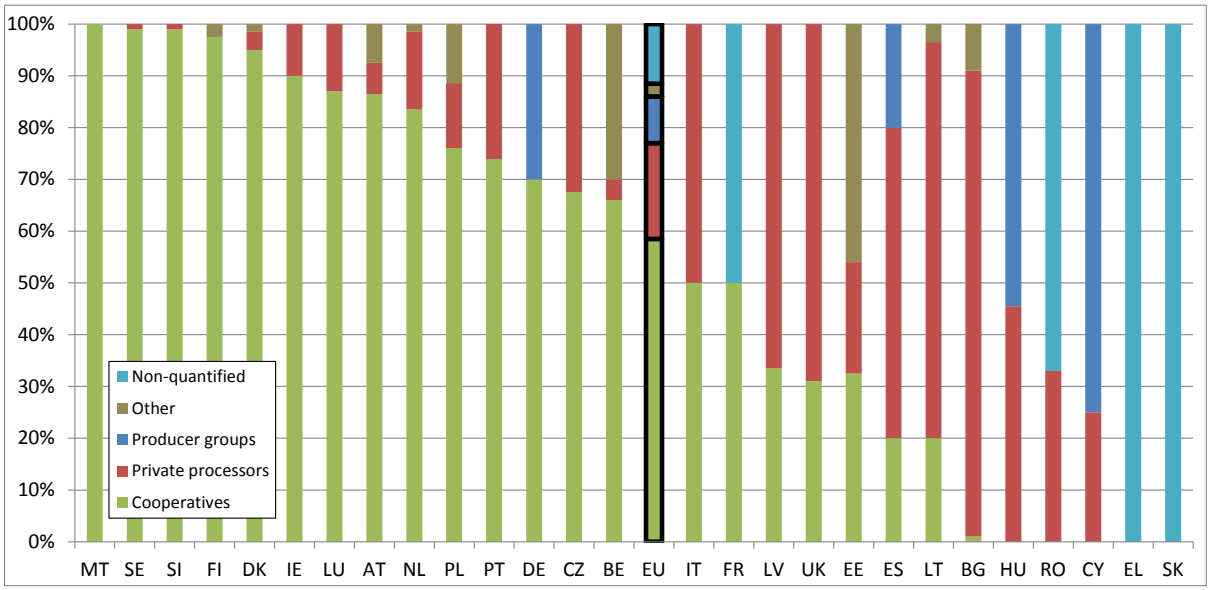


Figure 3.6 Share of milk production in EU Member States by type of processor
Source: European Commission (2009, 5).

MT: Malta, SE: Sweden; SI: Slovenia; FI: Finland; DK: Danmark, IE: Ireland, LU: Luxembourg, AT: Austria, NL: Netherlands, PL: Poland, PT: Portugal, DE: Germany, CZ: Czech Republic, BE: Belgium, IT: Italy, FR: France, LV: Latvia, UK: United Kingdom, EE: Estonia, ES: Spain, LT: Latvia, BG: Bulgaria, HU: Hungary, RO: Romania, CY: Cyprus, EL: Greece, SL: Slovakia

In 14 out of the 27 EU Member States, over 50% of the milk is delivered under cooperative arrangements (Figure 3.6). In many of the NMS the role of cooperatives is limited. Most MS characterise the contractual situation as rather stable, with an increasing role of cooperatives, where their current positions are weak (European Commission, 2009, 5). In member-cooperative relationships a cooperative statute applies. The main characteristics are the obligation on the side of the dairy to accept all the milk delivered, and the obligation of the producer not to sell to other buyers (exclusivity). Milk prices are determined by the governing bodies of the cooperative, which tend to be ex-post indicative prices (often one month ahead), which are adjusted later. The basic price is usually the same for all cooperative members, but is further differentiated by accounting for the fat/protein content of the milk delivered, and quality and quantity premiums. As regards the milk sold under contractual arrangements, usually these contracts are for 1 year, with price and volume fixed in the contract. From the European Commission (2009, 5) survey it turned out that in MS where cooperatives play an important role, the conditions for private contracts reflect those of the cooperatives (e.g. being long term (> 1 year), similar price setting mechanisms,

provisions to accept all the milk). At the same time it was indicated by several MS that agreements that do not take a written form and are much less formalised, can play an important role.

The biggest European milk processors were in 2009 among the top 20 biggest milk processors worldwide and covered 7% of the world production (Table 3.3). They are located in The Netherlands, in Sweden and in Denmark. Friesland Campina from The Netherlands along with Arla from Sweden/Denmark covered 1.6% and 1.2%, respectively, of the world´s processed milk. The French companies Lactalis and Danone are operating plants internationally and processed a share of 1.3% and 1.0%, respectively, of the world´s milk. Other European companies like Nordmilch (Germany), Bongrain (France), Parmalat (based in Italy with plants internationally) and Glanbia (Ireland) are also included in the ranking. The ranking of the European companies in this overview shows the dominant role of cooperatives in Europe. Cooperatives like FrieslandCampina, Arla Foods and Nordmilch play an important role on the global markets[1]. The companies listed in Table 3.3 process in total 21% of the world's milk intake.

Table 3.3 The world's largest dairy companies by milk intake in 2009

Company	Legal Form	Country	Main location of processing plants	Milk intake (million milk equivalent)	Market share (% of world production)
Fonterra	cooperative	New Zealand	International	18.6	2.7
Dairy Farmers of America	cooperative	USA	USA	16.2	2.3
Nestlé	Public	Switzerland	International	12	1.7
Dean Foods - USA	Public	USA	USA	11.8	1.7
CampinaFriesland	**cooperative**	**Netherlands**	**Netherlands**	**11.3**	**1.6**
Lactalis	**Private**	**France**	**International**	**8.9**	**1.3**
Arla Foods	**cooperative**	**Sweden**	**Denmark/Sweden**	**8.3**	**1.2**
California Dairies Inc.	cooperative	USA	USA	7.7	1.1
Danone	**Public**	**France**	**International**	**7.3**	**1**
Kraft	Public	USA	International	6.7	1
Land O´Lakes	cooperative	USA	USA	5.5	0.8
Saputo	Private	Canada	Canada/ USA	4.3	0.6
Nordmilch	**cooperative**	**Germany**	**Germany**	**4.2**	**0.6**
Schreiber Foods	Private	USA	USA	3.7	0.5
Bongrain	**Private**	**France**	**France**	**3.6**	**0.5**
Parmalat	**Public**	**Italy**	**International**	**3.5**	**0.5**
Murray Goulburm	cooperative	Australia	Australia	3.2	0.5
Northwest Dairy Assoc.	cooperative	USA	USA	3.1	0.4
Mengniu Group	Public	China	China	2.9	0.4
Glanbia	**Public**	**Ireland**	**Ireland/USA**	**2.8**	**0.4**
Sum				**145.6**	**20.8**

Source: IFCN, 2009.

The leaders of the European dairy industry continue to foster strategic alliances, acquisitions and consolidations in order to improve performance and gain economies of scale. For example, Lactalis, through its acquisition, in March 2010, of Ebro Puleva, has now become the second largest dairy company in Spain.

However, the real growth of the dairy market, is shifting towards developing markets. Lactalis's investments in Central and Eastern Europe reportedly bring the company a major percentage of its retail value, and Danone's merger with Russia's Unimilk, giving them 7.8% of the market,

[1] See for further details with respect to the main processors their websites: Danone www.danone.com; Lactalis www.lactalis.fr; Friesland Campina www.frieslandcampina.com; Arla Foods www.arla.com; Parmalat www.parmalat.com; and Bongrain www.bongrain.com.

underlines this trend. Other dairy industry leaders, like Nestlé and Friesland Campina, can be seen to be also looking further afield towards Asia, an area seen as offering future growth opportunities.

The launching of many functional and preventative products that address health and wellbeing is clearly on the increase as producers try to address consumer's demands (see: http://www.activiapromise.com/). Dairy products continue to inspire trust. Dairy products can also offer benefits like Omega 3, Anti-oxidants, added calcium, Vitamin D, protein enrichment, low fat, organics and others, though the definition of many of these terms and specifically the term 'natural', will become increasingly under scrutiny in the coming years.

Meanwhile, the industry is responding to consumer's concerns (see Chapter 2: Global consumer trends shaping the dairy industry). With the concern for health also comes a continuing consciousness of the effects of packaging on the environment. This is exposed by a recent survey made by UBIFrance, which highlights the European consumer's concerns and their preference for sustainable packaging solutions such as, 'light-weighting', bio-degradability and recycling. With most milk packaging today in HDPE bottles (High Density Polyethylene), or in Tetra type, cartons, which due to their multiple laminates are rarely recyclable or need special facilities, there is now a growing consumer preference for environmentally friendly solutions, which is, in turn, fuelling the growth of many new packaging developments (Hemming, 2011).

Some examples include:

- The 'Ecolean' plastic formed pack, who announce on their website, that: "By using a minimal amount of raw material we create a lightweight package which combines low environmental impact with consumer convenience http://www.ecolean.com
- The 'Green Bottle' introduced by Marybelle in the UK, which consists of a cardboard pulp outer bottle and an inner plastic bag, said by PIRA to have reduced the carbon footprint, compared to a standard HDPE bottle, by 48%! http://greenbottle.com
- Dairy Crest's 'Jugit', which by offering a re-usable jug, allows milk to be delivered in minimal simple plastic bags http://www.jugit.co.uk/

3.5 Consumption

Contrary to the market development of liquid milk and butter, the EU is an increasing market for cheese. The diversity in dairy consumption between Member States is high, as is shown in the Tables 3.5, 3.6 and 3.7.

Table 3.5 Liquid milk consumption in the European Union, 2007-2009

	1,000 tons			kg per capita		
	2007	2008	2009	2007	2008	2009
EU 27	**32,795**	**32,563**	**32,188**	**66.2**	**65.4**	**64.5**
United Kingdom	6,429	6,351	6,449	105.4	103.4	104.4
Germany	4,327	4,435	4,409	52.6	54.0	53.9
Spain	4,140	4,110	4,130	91.6	89.2	88.4
France	3,767	3,699	3,699	60.6	59.2	59.2
Italy	3,706	3,708	3,211	62.7	62.2	53.5
Poland	1,757	1,678	1,641	46.1	44.0	43.0
The Netherlands	1,009	991	989	61.6	60.3	59.6
Sweden	966	955	925	105.6	103.6	99.4
Finland	706	700	694	133.2	132.1	131.0
Austria [1)]	654	660	660	78.7	79.2	79.2
Czech Republic	524	554	627	50.5	52.9	59.7
Ireland	625	625	625	144.0	141.3	140.2
Hungary	573	540	589	56.9	53.8	58.7
Belgium	580	574	574	54.8	53.9	53.5
Denmark	492	497	496	90.1	90.6	89.9
Slovakia	283	261	268	52.4	48.3	49.5
Estonia [1)]	183	188	188	136.1	140.4	140.4
Lithuania	89	95	101	26.4	28.3	30.3

Other	1,986	1,941	1,913	34.9	34.1	33.6

1) Including milk drinks, fermented products.

Table 3.6 Butter consumption in the European Union, 2007-2009

	1000 tons			kg per capita		
	2007	2008	2009	2007	2008	2009
EU 27	**1,815**	**1,769**	**1,740**	**3.7**	**3.6**	**3.5**
France	501	493	493	8.1	7.9	7.9
Germany	524	510	462	6.4	6.2	5.6
United Kingdom	195	169	183	3.2	2.8	3.0
Poland	160	164	168	4.2	4.3	4.4
Italy	120	111	98	2.0	1.9	1.6
The Netherlands	56	54	56	3.4	3.3	3.4
Czech Republic	43	50	53	4.1	4.7	5.0
Austria	42	40	40	5.1	4.8	4.8
Belgium	25	26	26	2.4	2.4	2.4
Spain	21	22	22	0.5	0.5	0.5
Sweden	14	14	17	1.5	1.6	1.8
Finland	15	14	15	2.8	2.7	2.9
Slovakia	11	12	15	2.1	2.2	2.8
Ireland	11	11	11	2.6	2.6	2.5
Denmark	10	10	10	1.7	1.8	1.8
Hungary	9	9	10	0.9	0.9	1.0
Greece	8	8	8	0.7	0.7	0.7
Lithuania [1)]	4	5	7	1.3	1.4	2.2
Latvia	6	6	6	2.4	2.6	2.7
Estonia	5	6	6	3.5	4.3	4.3
Other	36	37	35	0.8	0.9	0.8

1) Blends included. Including intervention buying in 2009.

Table 3.7 Cheese consumption in the European Union, 2007-2009

	1000 tons			kg per capita		
	2007	2008	2009	2007	2008	2009
EU 27	**8,142**	**8,223**	**8,297**	**16.4**	**16.5**	**16.6**
Germany	1,835	1,825	1,852	22.3	22.2	22.6
France	1,591	1,624	1,627	25.6	26.0	26.1
Italy	1,234	1,239	1,256	20.9	20.8	20.9
United Kingdom	684	721	676	11.2	11.7	10.9
Poland	408	408	412	10.7	10.7	10.8
Spain	335	345	385	7.4	7.5	8.2
Greece	326	350	350	29.2	31.2	31.1
The Netherlands	352	337	349	21.5	20.5	21.0
Sweden	161	170	176	17.6	18.5	18.9
Czech Republic	176	170	175	16.9	16.2	16.7
Belgium	170	168	167	16.1	15.8	15.6
Austria	147	145	145	17.7	17.4	17.4
Hungary	108	110	110	10.7	10.9	11.0
Finland	105	106	110	19.9	20.0	20.7
Denmark	90	90	90	16.5	16.4	16.3
Slovakia	53	50	52	9.8	9.2	9.5
Lithuania	46	48	49	13.6	14.3	14.5
Latvia	29	30	30	12.7	13.0	13.0
Ireland	31	27	27	7.1	6.1	6.1
Estonia	25	23	23	18.8	17.1	17.1
Other	237	237	237	5.4	5.5	5.4

As Europe is increasingly becoming an urban society, with limited access to nature, consumers have developed an interest in a more healthy and balanced lifestyle. More and more, over the past decades, the dairy industry has been creating products that respond to consumer's health and wellness concerns, in an attempt to answer the need to get back to all things authentic and natural.

Another movement comes from the evolution of changing lifestyles. Today, with the growth of single households, or households where both partners are working, the time of the 'sit-down' family meal seems to have lost its dominance. With many meals now eaten on the go, starting the day often comes down to perhaps a dairy drink and a few biscuits in the car or eaten on public transport. This is certainly brought out by Tetra Pak's Dairy Index, which says the demand for LDP (Liquid Dairy Products) is increasing, once again. TetraPak put this down to growing urbanisation, aging populations and a growing middle class. This fast pace lifestyle is driving a need for convenience and practicality. With snacking replacing other meals, there is now a need for more convenient portion sizes, and smaller and more accessible packaging (Tetra Pak Index, 2011).

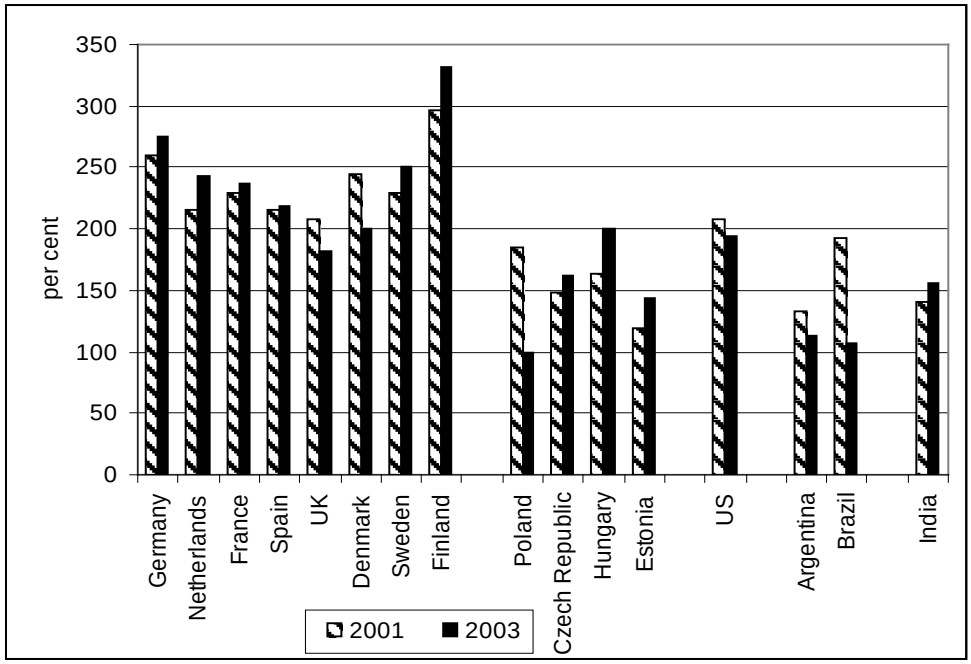
3.6 Competitiveness

The most comprehensive information on milk production costs worldwide is collected by the IFCN (International Farm Cost Network), but this is not in the public domain. From secondary publications that have used these data, data for two sub-periods have been found: for the years 2001 and 2003.

Figure 3.7 shows the milk production costs of a number of countries, relative to those of Oceania (average of New Zealand and Australia) in 2001 and 2003. In this database, the UK has the lowest production costs in Western Europe (defined in this data source as EU Member States plus non-EU countries Norway and Switzerland), more or less on a level with those of the USA, but nevertheless about double the cost of production in Oceania. As Figure 3.7 shows, India has lower costs of production than all selected EU member states, although their cost is still about 1.5 times as high as that of Oceania.

Information that could be found for 2007, indicates that Western Europe still had the average highest milk production costs worldwide (€42.30/100kg).

Figure 3.7 Average milk production costs relative to Oceania, 2001 and 2003



Source: own compilation based on IFCN (2002 and 2004).

Due to the EU's CAP policy reforms, several of its agricultural sectors have become more competitive. However, the EU dairy sector is still not competitive at world market prices, although the recent and coming EU dairy policy changes (quota abolition) are increasing the market orientation of the EU dairy sector.

3.7 Trade

3.7.1 Dairy trade policy: tariff and non-tariff measures

The EU is the world's largest exporter and importer of food products ate the same time. Trade in food products is subject to various regulations, including both tariff and non-tariff measures. Non-tariff measures consist of sanitary and phytosanitary measures (health standards, contamination standards, rules for genetically modified organisms, fumigation requirements), quality standards, labeling and packaging rules, bans monitoring and licencing requirements, state trading enterprises, customs procedures, notice and comment procedures, and corruption. NTMs usually are aimed at protecting consumers (health), but can have also significant trade distorting impacts (e.g. non-science based standards). This holds in particular when the standards or requirements a country imposes goes beyond internationally accepted standards (such as for example the Codex Alimentarius/SPS agreement). Unlike tariffs which are normally applied equally to all trading partners, NTMs can affect the imports form some specific countries disproportionally. Aside from tariff and non-tariff trade measures, the CAP is affecting the EU dairy sector and co-determining its long run evolution, including the EU's position as one of the world's leading exporters of dairy products.

The EU's common market organization for milk and milk products became operational on 1 November 1964. Its objectives were in line with the general principles for the common agricultural policy laid down in Article 39 of the Treaty of Rome (1958), namely (1) to increase productivity, by promoting technical progress and ensuring the optimum use of the factors of production, in particular labour; (2) to ensure a fair standard of living for the agricultural community; (3) to stabilise markets; (4) to secure availability of supplies; and (5) to provide consumers with food at reasonable prices. (See next Section for more details on the EU's Common Agricultural Policy with respect to dairy).

Given that milk and milk products were heavily subsidised at national level by the six founder members of the EC and that milk production was perceived to be very important for the farmers' income, already from its start a high level of price support was built into the common market organisation for milk. The price of milk was initially supported by variable import levies, in order to insulate domestic dairy product prices from those on world markets, and by an intervention buying system that would take supplies of butter and skim milk powder (SMP) off the domestic market when their prices fell below an intervention price, store them and subsequently release them back onto the market when prices recovered. Already very quickly after its inception, the cost and magnitude of intervention stockholding became problematic. Regulation 25 of 1962, setting up the European Agricultural Guidance and Guarantee Fund and establishing the rules for financing the common agricultural policy, had made provision for the mechanism whereby surplus products could be exported with refunds (export subsidies) to third countries.

Tariff measures by the EU

Export refunds are awarded using the method considered the most suitable and creating the lightest administrative burden. The refund amount established takes into account a series of factors, such as the price of the milk and the costs of marketing. Subsidised exports of butter and SMP from intervention and periodic 'distress' sales to targeted outlets on domestic markets were used from the 1970s in an attempt to manage the EEC's growing milk surplus. In 1984, supply controls in the form of annual quotas on the amount of milk delivered to dairies and sold directly by farmers to consumers were introduced. The quota system imposed an effective limit on the problem of surplus production.

The historical purpose of export refunds was to enable EU exports to compete on the generally lower-priced international market. As shown in Table 3.8, expenditure on refunds and subsidised volumes for butter were higher in the years 2003/4 to 2005/6 than in the late 1990s/early 2000s, and the average refund per tonne remained around €170-190 per tonne. For cheese, the figures show small fluctuations around a more or less constant level from the late 1990s to the mid-2000s. By contrast, the figures for SMP show much more volatility over the same period. From 2006 and onwards, the picture changes. Subsidised volumes and/or the rate of refund paid were much lower for all the product categories shown in Table 3.8, and export refunds were almost not

used at all in 2007/08. However, in January 2009 export refunds were reintroduced to help support EU market prices in the wake of the crisis in the milk sector and the sharp decline in world prices. Nonetheless, the quantities subsidised and the refund rates were far lower than in the earlier part of the decade.

The largest quantities of cheese exported with refunds in 2009/2010 were traded from The Netherlands, Germany, France and Finland, whereas for skim milk powder in the same period, the largest quantities were exported with refund from Belgium, France and Germany. However, it is important to note that these products circulate easily within the single market of the EU and EU exporters are free to choose the port of departure for their products. Therefore, the Member State from which products are exported is not always the Member State in which they were produced.

Table 3.8 Total subsidised exports and average refund paid

Periods from July to June	Quantities in 1000 tonnes				Average Refund paid in €/100 kg				
	Butter	SMP	Cheese	Other dairy products	Butter	SMP	Cheese	Other dairy products	Weighted average
1995-1996	146	241	422	1157	175	58	104	63	
1996-1997	276	269	402	1141	200	63	68	64	
1997-1998	169	176	324	1117	184	66	54	68	
1998-1999	165	221	226	951	173	87	66	80	
1999-2000	194	417	305	1104	172	81	77	82	90
2000-2001	197	128	305	873	171	20	78	47	67
2001-2002	194	87	279	764	168	42	68	53	72
2002-2003	292	220	317	833	187	74	84	72	95
2003-2004	353	259	321	880	175	55	74	72	90
2004-2005	354	212	300	827	146	31	52	49	68
2005-2006	295	117	317	737	99	13	45	38	49
2006-2007	3	126	291	458	3	20	37	28	30
2007-2008	0	0	0	16	0	0	0	12	12
2008-2009	98	126	134	466	55	20	18	21	24
2009-2010	71	129	128	409	59	25	19	24	27

Source: DG AGRI (unpublished).

Imports and exports may be subject to issue by the Member States of an import/export licence. In general, in EU external trade, milk and milk products are subject to the rates of duty in the common customs tariff; taxes having equivalent effect to customs duty and the application of quantitative restrictions or measures of equivalent effect are prohibited[2]. In certain cases, such as where the free-at-frontier price significantly exceeds the Community price and threatens to cause long-term disruption to the proper functioning of the Community market, the Community may fully or partially suspend import duties and even collect export levies.

The EU generally maintains relatively high import tariffs on dairy products, in order to sustain the EU market price (see Table 3.9 for an illustrative overview). There are only minimal imports at full tariff. However, many of the EU's trading partners benefit from special import arrangements – known as Tariff Rate Quotas (TRQs) – whereby imports can come in at lower tariffs. Some of the TRQs are specific to particular exporting countries; others are open to all under the most-favoured nation (MFN) system. TRQs are established for powders (SMP, WMP), different cheese types and butter. They are not always filled (i.e. fully utilised).

Table 3.9 EU Import tariffs for selected dairy products
(€/ton)

[2] Additional duty may be charged under the conditions set out in the agriculture agreement of the World Trade Organisation (WTO). The Community informs the WTO of the trigger prices below which additional duty may be charged.

dairy product	5D-code	import tariff	price *)	as fraction of EU price
butter	40510	1896	3300	0.57
SMP	40210	1188	1785	0.67
WMP	40221	1619	2090	0.77
Cheese	40630	1449	3500	0.41

*) Estimate of domestic EU price based on 2010 data for EU-27
Source: EU TARIC data base (accessed March 15, 2012)
(http://exporthelp.europa.eu/thdapp/display.htm?page=intro%2fintro_Welcome.html&docType=main&languageId=en)

Safeguard measures may be taken if the Community market is threatened with serious disturbance by reason of imports or exports. In addition, under certain circumstances, recourse to inward processing arrangements may be prohibited.

In implementing the dairy trade policy measures[3], the Commission is assisted by a Management Committee for Milk and Milk Products, comprising representatives of the Member States and chaired by a representative of the Commission.

Non-tariff measures applied by the EU
Alongside the impact of the CAP and the role of tariff measures, several non-tariff measures affect the EU's trade in food products. NTMs include a variety of measures, with two major nontariff barriers being sanitary and phytosanitary (SPS) measures and customs and administrative procedures.

- On dairy products the EU food safety legislation applies. This policy is based on the information flow along the food value chain, with as a fundamental requirement traceability in order to ensure the production of healthy food at all levels[4].

Aside from some sector wide measures (for example customs related measures such as tightened security measures), there are also subsector specific measures, in particular in the dairy, meat and beverage sectors. These measures contain:

- differences in certification regulations between the EU and India,
- differences to the effects of up- or downstream components in products (with the EU requiring component information).
- Food hygiene and labeling legislation between the EU and India diverges, making it less easy for India to export to the EU, without taking additional efforts.
- In order to export to the EU, a country needs to have firms, registrated and certified by the EU, which might exclude many safe high quality export plants.

Tariff and Non-tariff measures faced by the EU when exporting to India
EU dairy exports to India are subject to Indian tariff and non-tariff regulations. For an overview of the tariff structure on dairy products of India see Section 4.8 below. With respect to the tariff measures we found that:

- Some EU exporters indicated a lack of transparency of the rates which apply, which is due to the regular changes India make with respect to its applied tariffs

From an explorative research of the literature (including some grey literature, US ITC, 2009 a.o.) and a few interviews with Dutch dairy experts/traders the following picture emerged with respect to the NTMs. Some EU agricultural exports of dairy products are facing:

[3] See Council Regulation (EC) No 1255/1999 of 17 May 1999 on the common organisation of the market in milk and milk products, and amending acts.

[4] According to an EU sanitary standards dairy products manufactured from milk has to be derived from cows which kept in farms and machine milked. Given the predominance of hand milking in India this effectively precludes smallholder producers and much of India's milk output from exports to the EU.

- Hindrance from health standards applied to dairy products that exceed internationally accepted standards, as well as Indian domestic standards;
- Customs procedures that create uncertainty regarding paperwork and valuation;
- Notice and comment procedures that hinder information dissemination about rules affecting imports.

3.7.2 Trade patterns in dairy products

The EU is a major supplier of milk products at the world level, and EU net trade (exports minus imports) is positive with regard to cheese, butter, skimmed milk powder and whole milk powder (Table 3.9 and Figure 3.8).

Table 3.9 - EU import, export and net trade of cheese, butter, SMP and WMP, 2009 (1000t)

	Cheese		Butter		SMP		WMP	
	Import	Export	Import	Export	Import	Export	Import	Export
Extra-EU	84	553	49	103	5	217	3	426
Other Europe	53	233	2	24	2	16		8
Oceania	26	14	45	1				
NAFTA	4	114		2		3		1
Other America		16		2		5		38
Asia		65		20		65		39
Middle East		59		32	1	20		136
Africa		53		21		108		203
Rest of World			1				2	
EU net trade	469		54		213		422	

Source: UN Comtrade

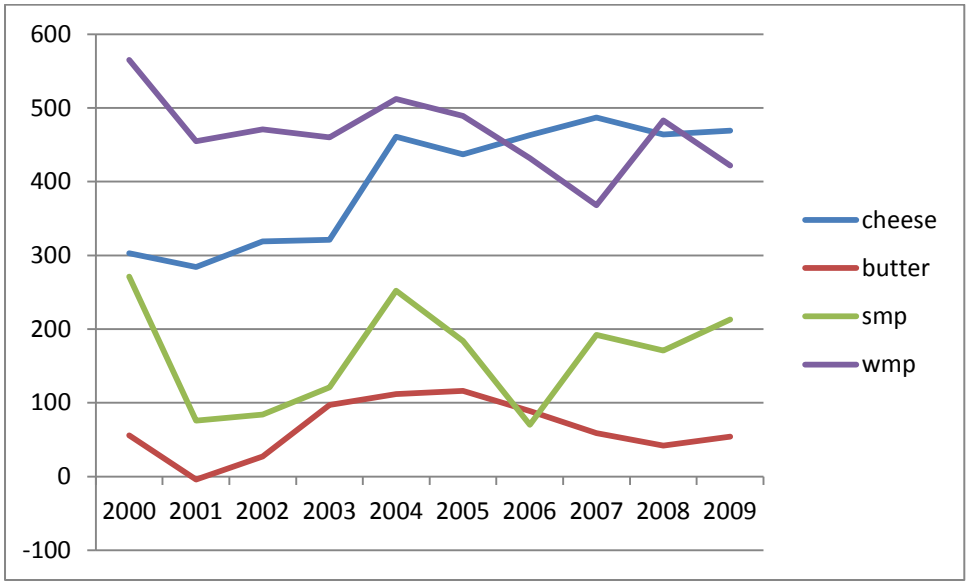


Figure 3.8 - Development of EU net trade of cheese, butter, SMP and WMP

Cheese

At the beginning of this century, the EU was importing from Australia, New Zealand and Switzerland, in basically equal proportions. The demand of Swiss cheese has remained stable all along, including since 2005, but the imports from Australia declined to a quarter of imported quantities in 2001, and imports from New Zealand declined to a third. EU exports of cheese are slightly greater in volume than exports of WMP, but there is no comparison here in

terms of added value. The North American share of exports is about 30%, especially the USA, followed by Canada and Mexico in equal parts. Russian demand has grown from about one-eighth to 30% of total EU export of cheese. About another 30% of EU export goes to other countries. The remaining fraction of exports goes to the Middle East. Net trade is positive for the EU, with export more than doubling imports.

Butter

Imports of butter come from two major trading blocs until 2005: New Zealand and the former EU-10 accession countries. After accession, the importance of imports from New Zealand remained, but the EU-10 trade became part of internal exchange between EU MS, and net imports into the EU *per se* correspondingly dropped. The export situation primarily concerns North Africa, the Middle East and Singapore, with other countries representing about a third of all exports. The balance of trade in butter is positive for the EU, with quite some variation (1:7) over the time period 2001-2008.

Whole milk powder

The EU has not imported much WMP during the period 2001-2008, and most came from the former EU-10 accession countries. Imports dropped by almost 90% between 2003 and 2005 (May 1st, 2004 being the accession day), and has been declining ever since. Exports, however, have always been substantially more important (about 25 times greater) than imports, by volume. The demand comes mainly from Africa and the Mid-East, but also from Latin American countries. Other demand has generally been over a third of exports. Exports have basically remained stable over the period 2001-2008. Net trade in WMP has, therefore, continuously been very positive for the EU, averaging just under 500.000 tonnes.

Skimmed milk powder

Imports of SMP have basically been coming from Central and Eastern European countries, but have declined by 80% since the accession of the EU-10 countries. The remaining import sources are spread evenly between the USA, Switzerland and other countries. Exports are primarily to North Africa and the Far East (Asia). The balance of trade with regard to SMP is positive for the EU, and seems to be progressively increasing, but within a range of about 1:3.

Figure 3.9 provides an overview of the value of EU dairy exports to India during the period 2007-2010. It should be noted that this is a period in which world commodity markets, including those of dairy were disturbed. Note that the exports of cheeses show a relatively stable and increasing pattern. This corresponds with the observation made before that there is an emerging market demand for cheese in India, which is reflected in increasing imports of cheese and curd. Concentrated milk and cream ranks second in importance. For the other products exports are less important and are more fluctuating over time. More generally, the export of dairy products from the EU to India is relatively small.

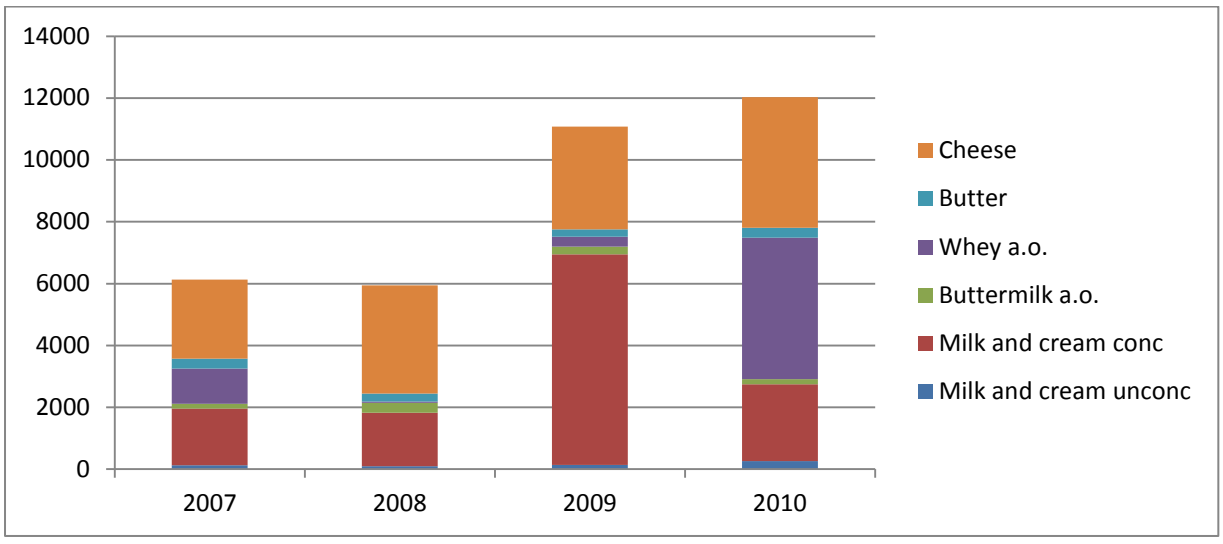


Figure 3.9 Export of dairy products from the EU to India (x €1000)
Source: Comtrade and Comext data base

Trade in Dairy equipment

India has made considerable progress in the manufacture of dairy equipment with the emergence of several equipment manufacturers. Some of them have exclusive tie-ups with foreign equipment players for providing advanced dairy equipment for the Indian dairy industry. The growth of the dairy equipment sector has picked up mainly because of growth in the organized dairy sector over the last decade. The industry is showing growth in certain categories such as road tankers, storage tanks, bulk milk coolers, small homogenizes, milk pasteurizers, milk vending machine and liquid milk packaging system etc. Equipment for packaging of butter, cheese, paneer and other traditional products need focused attention for tapping small and medium scale operations.

The increase in processing levels in the organized sector from 20% currently to 30% in the next 5 years should lead to building up of new capacities. There is ample scope for manufacturing equipment for basic products like ghee, paneer, indigenous sweets (khoa, peda) etc. Further value added products like ice cream, cheese, powder, yoghurt, UHT milk plants require specific equipment and machineries for setting up the plant (Rabo India Finance Ltd, 2010).

Figure 3.10 shows an index of export from the EU27 to India and India's imports from the world of dairy processing equipment. The sum of the export values includes engines and motors, pumps for liquids and liquid elevators, air and vacuum pumps, refrigerators, freezers, centrifuges, weighing machinery, milking machines and dairy machinery, machinery for the preparation of food or drink and other machinery parts. Those equipment is part of category 84 of the HS 2-digit industries.

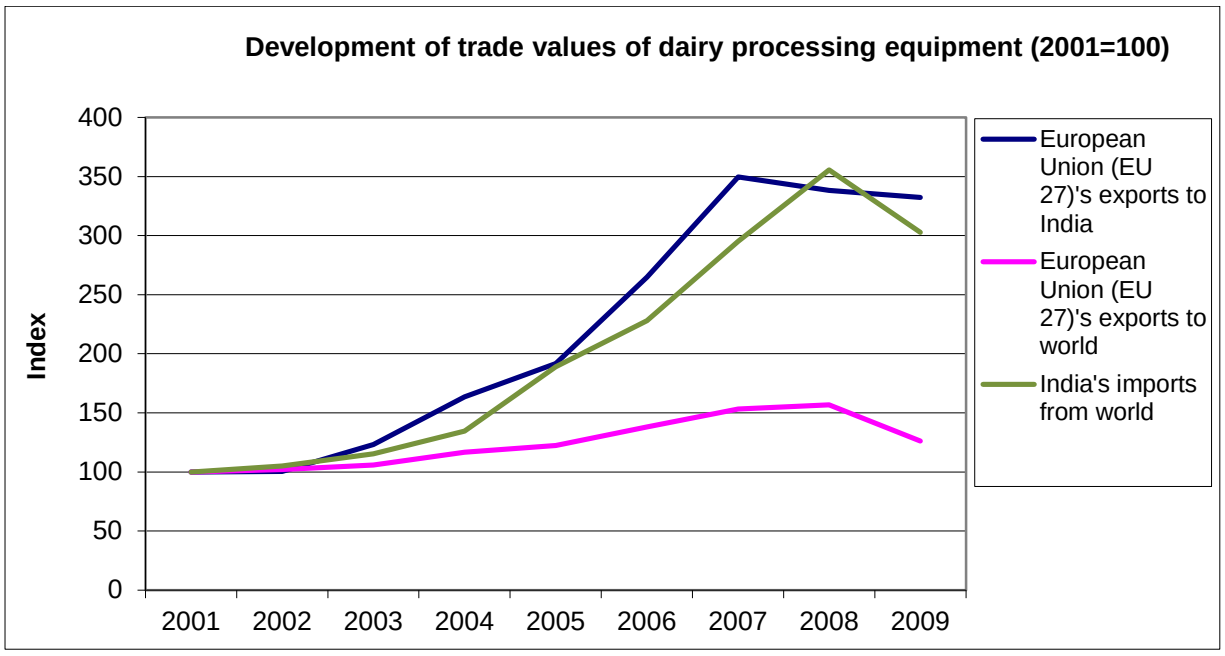


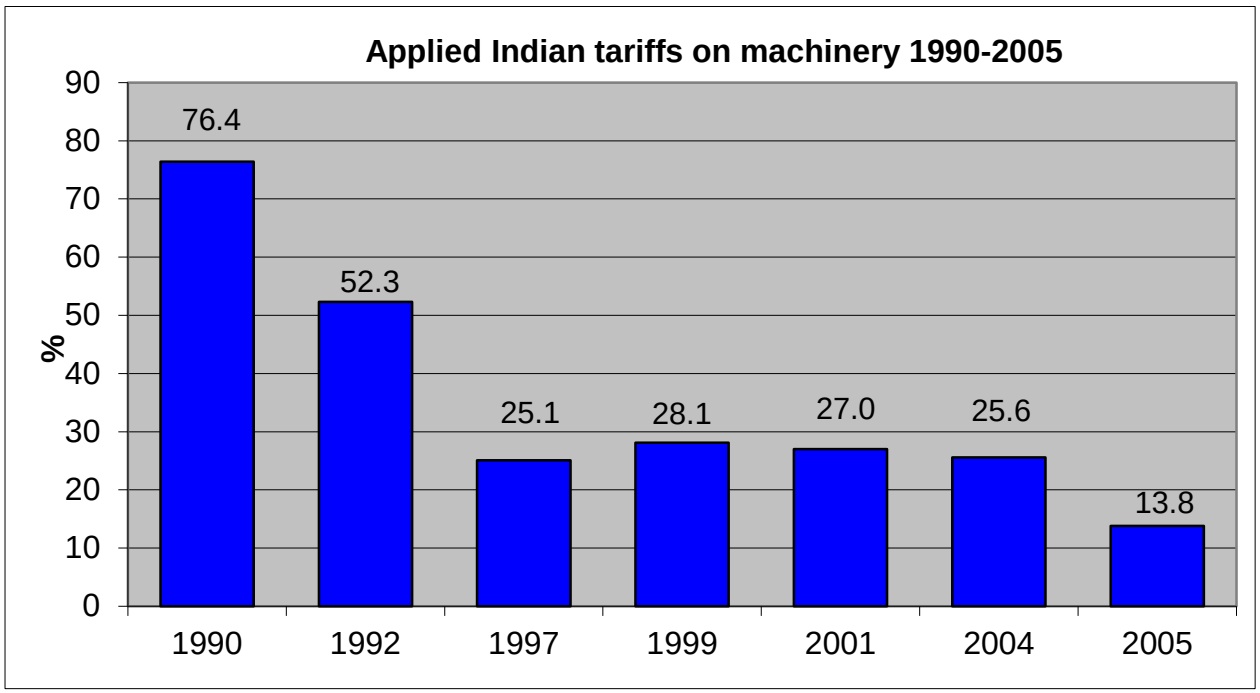
Figure 3.10 Development of EU and India trade values of dairy processing equipment

As shown in figure 3.10 the export from the EU to India and India's imports from the world are increasing annually. 2009, the year of the worldwide economic recession, shows a slight decrease. The last few years the export value of the equipment mentioned above from the EU to India is almost one billion euros. The EU export to India is about 1% of the total export from the EU to the world of those specific equipment (Trade Map, 2010).

As is further shown in figure 3.10 the value of India's imports from the world and the export value from the EU to India is increasing. Also the total export value from the EU to the world is

increasing. However, proportionally the export from the EU to India rises quicker than the export to the world. Those values include all kinds of equipment mentioned above.

Below the development of the applied Indian tariffs on machinery is shown (Trade Map, 2010). Tariff measures are created to protect the internal market. Import tariffs should make it less attractive to suppliers in foreign countries to import products in the home country (India). The dairy equipment sector in India is protected with customs duty of 7.5% along with countervailing duty and SAD (Special Additional Duty) on almost all dairy equipment (other than milk clarifiers). Clarifiers are exempted from import duty with an intention to boost clean milk production in the country. The fresh packed liquid milk requires basic processing and packing technology at plant level. Costs of the equipment and after sales maintenance service will remain key drivers for future growth.



Source: Trade Map, 2010
Figure 3.11 - Applied Indian tariffs on machinery 1990-2005

According to Figure 3.11 the applied India tariffs on machinery have decreased for the last 20 years. This machinery sector is one of the sectors which experienced the largest decline in tariffs, in the order of almost 80% in 1990 till less than 15% in 2005. This later was even decreased to 7.5%.

The range of equipment presently manufactured by the indigenous manufacturers include stainless steel dairy equipment, evaporators, milk refrigerators and storage tanks, centrifuges, clarifiers, homogenizers, spray dryers and heat exchangers (tubular and plate type) etc. In recent years many dairy plants have been commissioned by the National Development Dairy Board and the majority of equipment have been supplied by indigenous manufacturers. Advanced equipment like spray dryers, plate type heat exchanger and other core equipment require advanced technology to manufacture a good quality product bacteriologically.

Common dairy equipment used are plate heat exchangers, homogenizers, cream separators, packaging machines, storage tanks etc. All these equipment are widely available in India and are the mainstay of any dairy company dealing in selling fresh milk. For large scale plants (they usually prefer a mix of domestic and foreign equipment), foreign players might be a preferred partner.

Some of the domestic companies in India are already exporting their products (e.g. milking equipment, cans, milk testing instruments, bulk milk coolers etc.) to African and neighboring countries in South Asia. This segment is growing at double digit rate. This can be an opportunity worth exploring for players in Europe (Rabo India Finance Ltd, 2010).

An earlier study shows calculated peaks and averages of non-tariff barriers. According to the WTO database the Indian non-tariff barrier (NTB) of the HS 2-digit chapter 84 (nuclear reactors, boilers, machinery, etc.) has an average of about 6,2%. Such low percentages do not have much impact on prices. The influence of NTB would therefore appear to be fairly clear, as they protect the markets in which EU has potential to expand (Caris, *Qualitative analysis of a potential Free Trade Agreement between the EU and India*).

Motivation to export
There are several reasons to export or start exporting dairy processing equipment to India. Suppliers think it is a big challenge to export to India. India is a new and very large market so there are much opportunities. Only 20% of the milk production is processed. This results in a big potential of investment: exchanging the traditional manual processes into automatic processing. People in India do speak English reasonable, which makes it easy to communicate. The most given answer to the question 'what would be the motivation to export products to India' is 'making money' or utilizing the business opportunities.

Motivation not to export
Suppliers think there have to be build a relationship between the EU and India before free trade is possible. The attitude is disinterested. Suppliers say the Indians are not that concrete and direct as Russian people for example. The experience is that the Indians think in other concepts. The Indians like soft cheeses. Also some respondents mentioned the risk of copying the products and produce it cheaper do the suppliers see as a danger for their own businesses. This risk could only be prevented by innovation and taking care of renewal. Furthermore the suppliers do receive few less signals from India, they think the Indians are not very interested in their products. Moreover, the Indian market is unknown and has to be explored before more trade will happen. Because of the very large market some suppliers think they need a local office to have success.

Small and medium-large suppliers of dairy processing equipment indicate they will not start exporting with the advent of the free trade agreement. Only the large companies state they may start to export. Often the export of equipment is (partially) managed by an agent in the foreign country.

Trade barriers
Language could be a barrier, though others indicate they think Indians speak English well and call this an advantage for Europeans. Also the lack of knowledge about the local situation in India is mentioned a barrier. However, some suppliers blame their selves for this, because of disinterest in India. Other suppliers respect their intellectual property. They have invested in innovation costs and do not want the Indians or others to take advantage of it.

3.7 Prices and policies

3.7.1 Overview

In the development of the EU dairy market since the 1960s four phases can be identified (Table 3.10).

Table 3.10 - Phases in the development of the EU dairy market

Period	Influential factor	Markets developments
1968-1983	Price support by CMO	• Expansion • Rising prices • Intervention ↑ • Costs ↑
1984-1995	Quota	• Volume ↔

		• Stocks ↓ • Exports↑
1995-2003	GATT	• Domestic market - • Consumption ↑ • Stocks ↓ • Prices ↔
2004-2015	CAP reform	• Deregulation • Volume ↗↙ • Prices ↖↘

Source: Wohlfarth, 2011

In the first phase the EU dairy market is regulated by the CAP, which removed trade barriers between the Member States and replaced the agricultural market and price policies of the individual Member States by a common market organisation (CMO). From the start the dairy system provided a common price floor. The chosen method of protecting external borders and introducing price-support measures on the internal market enabled the prices to be kept relatively high and stable in comparison to those on the world market.

The CMO consists of a collection of rules and regulations at the European level for a specific product (in this case: milk) and derivative products (dairy products). The rules establish both quality requirements (definition of the products) and economic regulation (e.g. price supports). The latter consists of import and export measures and internal support measures:

Import and export measures: products from third countries are not allowed to enter at the EU border at below the 'threshold' price, derived from the target price. Whenever the world offer price was lower than the threshold price, a variable import levy bridged the difference. The counterparts of the import levies are subsidies for exports, the so-called 'export refunds', which facilitate exporting to third countries when world market prices are below the internal level.

Intervention and sales subsidies: Alongside the external measures, the market organisations for dairy products also provide measures for the internal market, giving the intervention agencies established in each Member State the opportunity to buy up products (fulfilling certain quality criteria) at a specified 'intervention' price, below which the product price is not supposed to drop. The possibility of intervention purchase used to be permanent for butter and skimmed milk powder.

The dairy market posed problems from the outset of the CAP, because production was rising too fast compared to consumption. To combat this, various measures were introduced over the years, such as sales subsidies, herd conversion (to beef) and slaughter premiums, price reductions and producer co-responsibility levies.

Milk converted to intervention stocks of butter and skimmed milk powder caused large budget costs leading to the second phase with the introduction of milk quotas in 1984. This was intended to be a temporary measure to 1988, but was extended several times and now runs to 2015. In the first instance, the total EU milk quota was equal to 1981 supplies plus 1%, but later a substantial reduction was deemed necessary, and only at the end of the 1990s were the quotas slightly expanded again. Expenditure on the dairy regime fell steadily from the mid-1980s, with a particularly strong decline in the expenditure on storage and domestic sales in the years up to 2009.

The milk marketing quotas are allocated to individual businesses. Exceeding these quotas results in a high 'super' levy, initially set at 115% of the target price. The quotas are tradeable within many, but not between, Member States, some of whom still see the quotas as an important measure for preserving milk production in economically fragile agricultural areas.

Since WTO developments indicated that export support is being gradually phased out and that import tariffs will be reduced, it was decided in June 2003 to lower the intervention prices for skimmed milk powder and butter by 15% and 25% respectively, causing the fresh milk price to fall also. Compensation of approximately 60% was paid out for this, with payments – in total about 5 billion Euro – linked for the first few years to the quota, but since about 2007 included in the Single Payment Scheme.

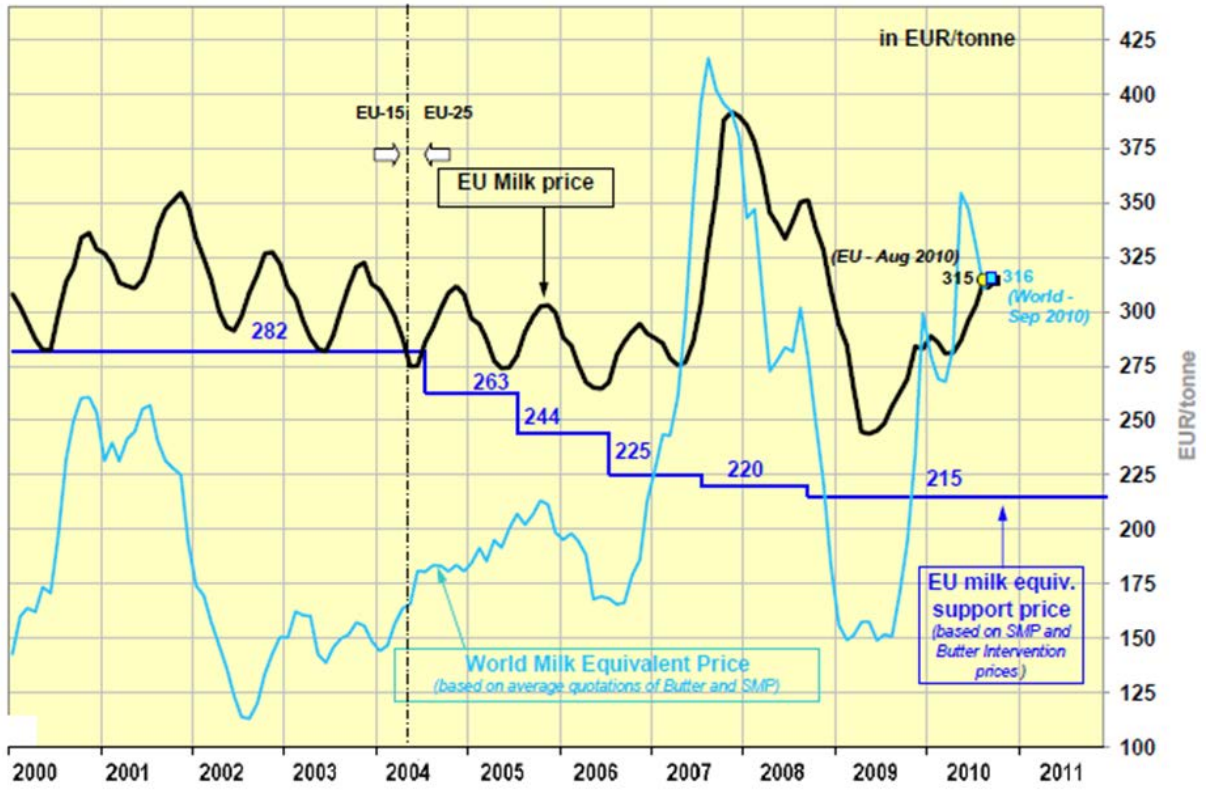
Due to the support price reductions and the high prices for dairy products on the world market, price support measures such as export refunds, domestic sales measures (bakers' butter, milk powder for feed) and intervention could be dismantled. By mid-2007, there were no intervention stocks for dairy products, and after the Health Check reform of 2008 intervention against a guaranteed price was limited to relatively small amounts. Prices of dairy products fell sharply in the course of 2009, and as a result intervention rules were changed so as to enable intervention for a longer period than originally foreseen.

Now that price support in the dairy sector has been largely replaced by decoupled direct income support, the discussion on ending milk quotas has reappeared on the agenda. During the negotiations on the Health Check proposals, there was a clear majority of Member States in favour of discarding quotas by the anticipated final date of 1 April 2015. Following a 2% quota increase in 2008/09, a 'soft landing' is approached in most Member States by increasing quotas by 1 per cent every year between 2009/10 and 2013/14.

In the day-to-day management of the dairy markets, the European Commission is assisted by the Management Committee for the Common Organisation of Agricultural Markets. This committee is attended by Member State experts, depending on which issues are on the agenda for discussion.

3.7.2 Recent developments

The ups and downs in world price movements of dairy products also affected the EU. Commodity prices reached unprecedented high levels in 2007 but fell gradually over 2008 and early 2009 causing a milk price crisis (Figure 3.12). The sector has since recovered from the lows of 2009. The price swings on the commodity markets were reflected in the farm gate price paid to milk producers, albeit with a certain delay and not to the full extent. The situation deteriorated for dairy farmers as input costs remained at relatively elevated levels, leading to a considerable squeeze on their gross margins. The price and income crisis induced actions by the European Commission to stabilise markets and provide a safety net to dairy farmers over the short term and establish longer term solutions.



Source:

Figure 3.12 - Milk price development in the EU 2000-2011

Despite the increased price volatility, milk delivered to dairies at the aggregate EU level did not produce considerable swings over the same period. While the annual change in the EU weighted average farm gate milk price was +14.5% in 2007, +8.7% in 2008 and -24.1% in 2009, milk deliveries displayed an annual variation of +0.2%, +1.2% and -0.6% respectively. The relatively inelastic behaviour of milk deliveries contributed to the magnitude of the price swings as the increased demand for dairy commodities was met with limited supplies and the eventual supply increase came at a period of deteriorating demand. EU intervention stocks quickly reached levels well beyond the quantitative limits at guaranteed prices in 2009 and significant quantities were bought in through the tendering procedure for butter and SMP.

By the end of 2009, intervention stocks stood at 77 thousand t for butter and at 257 thousand t for SMP. Commodity markets staged a fast recovery throughout the last quarter of 2009 and the second and third quarter of 2010. As a consequence, the release of EU intervention stocks under the food programme for the most deprived persons and through the tender procedure in 2010 did not cause supply pressure on the butter and SMP markets. The weighted average EU milk price reached 31.5 euro/100 kg in this period, exceeding average price levels registered between 2003 and 2006.

Quota less relevant

Milk quotas are gradually becoming less relevant. Milk production falls short of quota in an increasing number of Member States. According to official notifications by the Member States, the 2009/10 quota year is estimated to have ended with EU milk deliveries approximately 7% under quota (Figure 3.13).

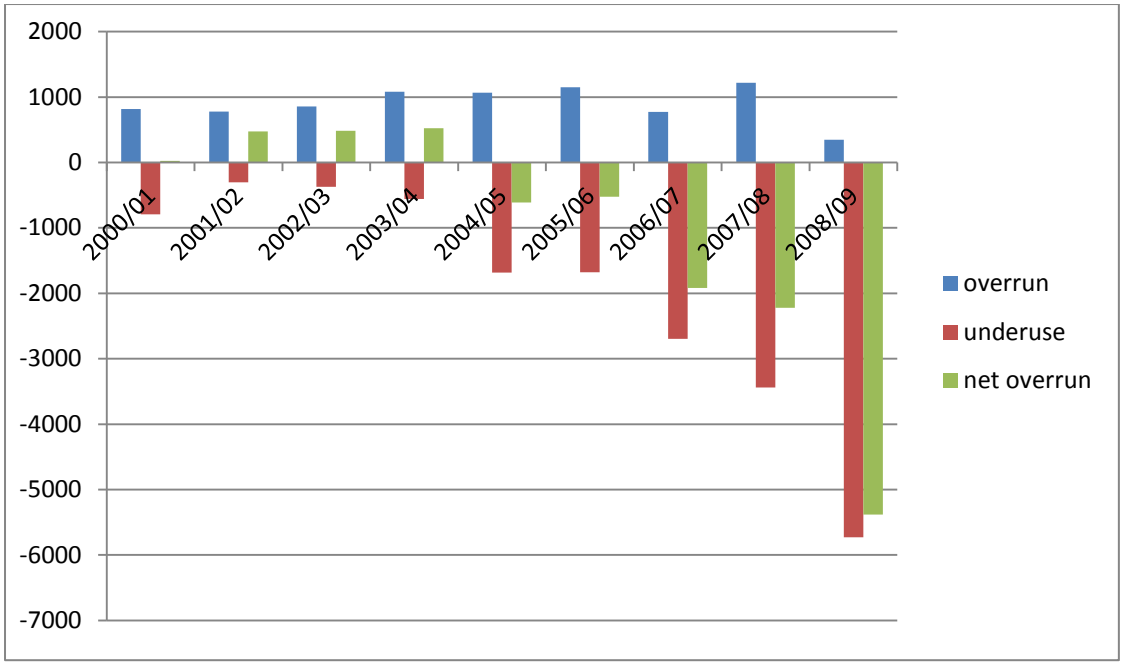


Figure 3.13 – Increasing underuse of milk quota (in thousand tonnes) in period 2000/01-2008/09

3.7.3 Market and price policy in the future

The core element of the reform process of the CAP has been the shift from product price support to producer income support. Rather than ensuring a fixed price for agricultural products such as butter and milk powder (and hence supporting farmers' incomes indirectly), the CAP today focuses on supporting farmers' incomes by direct payments. These payments were introduced to compensate the farmers for price reductions and were initially related to the production volume. For lower dairy support prices approximately 60% of the revenue loss was paid out directly, with payments – in total about 5 billion Euro – linked for the first few years to the quota, but since about 2007 included in the Single Payment Scheme.

Market instruments are used to provide market safety nets, but intervention prices are set at low levels which ensure that they are only used in times of real crisis. As the consumption of food is largely constant ('inelastic'), weather, disease and inevitable delays on the supply side may cause large price fluctuations.

In early 2009, the EU Agriculture Ministers adopted the legislative texts of the CAP Health Check. These steps towards a more market-oriented CAP came at a time when EU markets – for dairy in particular – were under pressure from low world market prices, and the Commission even decided to reintroduce export subsidies, and the likely purchase of significant public stocks of butter and milk powder.

In terms of achieving more market orientation, the Health Check agreement broadly accepted the Commission approach, resulting in fewer and simpler market instruments. The remaining coupled payments will now be decoupled and moved into the single farm payment. The only (but important) exceptions are for the suckler cow, goat and sheep premia, where Member States may maintain current levels of coupled support.

From 2003, Member States were allowed to retain 10 per cent by sector of their national budget ceilings for direct payments for use for environmental measures or improving the quality and marketing of products in that sector (Article 69). In the Health Check, it was decided that this possibility will become more flexible (Articles 68 to 72). The money will no longer have to be used in the same sector, but may be used to help farmers producing milk, beef, goat and sheep meat and rice in disadvantaged regions or pursuing vulnerable types of farming; it may also be used to support risk management measures such as insurance schemes for natural disasters and mutual funds for animal diseases.

The Health Check was not intended to be a major reform – more a completion of various issues deferred in the Fischler reform (2003/04), and a number of points aimed at making the CAP more defensible for the society at large, ahead of the next expected reform of EU farm policy after 2013. Among the driving forces are the new financial framework, the possible outcome of the WTO Doha Round, and discussion between old and new Member States about the distribution of agricultural support. Market support is already the smallest share of the CAP budget. However, market crises can emerge at any time.

The surge in agricultural commodity prices in 2007-2008 and the subsequent drop in 2009 led a substantial number of Member States to call for a new agricultural safety net to deal with the effects of price volatility on farmers' income. Whether this call will indeed be translated into new common agricultural instruments is not yet completely clear. Although many agricultural sectors (pork, poultry meat, horticultural products) are already familiar with high price volatility, such price volatility is new for dairy.

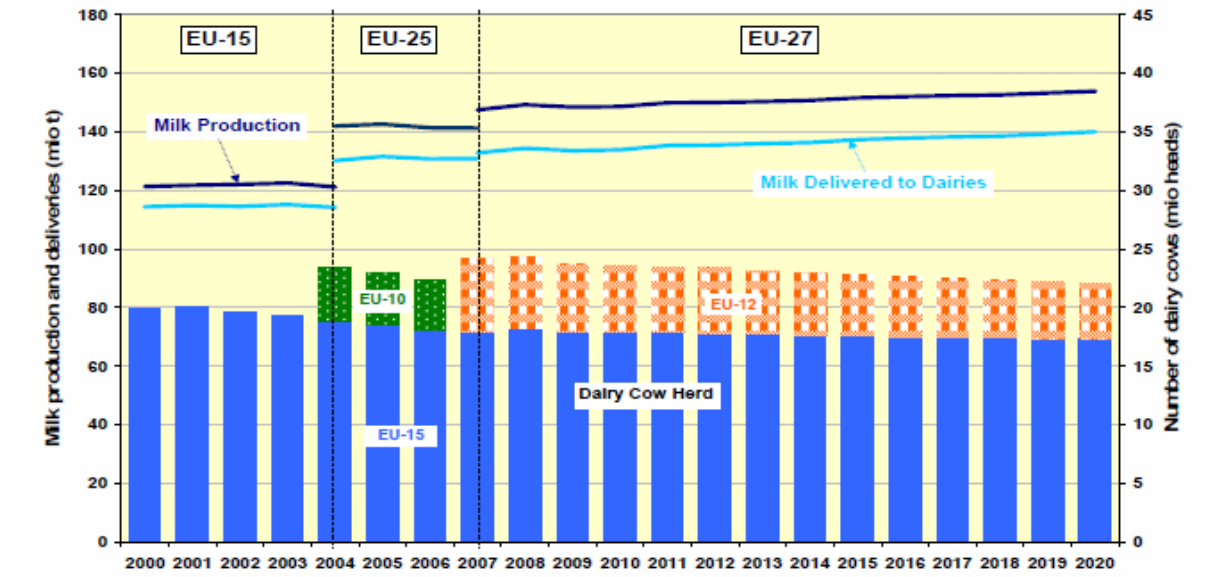
In December 2010, the Commission proposed new legislation to regulate the dairy production chain. The proposed legal changes provide for optional written contracts between milk producers and processors to be drawn up in advance of deliveries, which should include details of price, timing and volume of deliveries, and duration. Member States could make the use of such contracts compulsory in their territory. In its quest for rebalancing bargaining power in the supply chain, the Commission also proposes to allow dairy farmers to negotiate contracts collectively through producer organisations. Quantitative limits were proposed at 3.5% of global EU production and 33% of national production, with specific safeguards also provided to avoid serious prejudice in particular to small and medium-sized Enterprises (SMEs). In addition, specific rules for inter-branch organisations and measures for enhancing transparency in the dairy market were proposed. These measures are proposed to remain valid until 2020 with two intermediate reviews.

3.8 Outlook

According to the European Commission, milk production in the EU is expected to return to an increasing path, driven by a fairly optimistic demand outlook (European Commission, 2010). This market outlook is elaborated on the basis of specific assumptions regarding macroeconomic conditions, the agricultural and trade policy environment, weather conditions and international market developments. The projections are not intended to constitute a forecast of what the future will be, but instead a description of what may happen under a specific set of assumptions and circumstances, which at the time of projections were judged plausible. As such, they should be seen as an analytical tool for medium-term market and policy issues, not as a short-term forecasting tool for monitoring market developments and addressing short-term market issues. The projections and analyses have been carried out on the basis of economic models available in the European Commission (at the Directorate-General for Agriculture and Rural Development (AGRI) and in the Joint Research Centre – Institute for Perspective Technological Studies (IPTS)). It is based on the information available at the end of September 2010. The changes in legislation proposed or adopted since that date have not been taken into account. Moreover the projections do not take account of any potential outcome of ongoing bilateral/regional/multilateral trade negotiations. The analysis covers the period between 2010 and 2020.

The rate of increase of milk production will be rather moderate, with EU-27 milk production in 2020 projected to exceed the 2009 level by less than 4% (Figure 3.14). Milk deliveries would increase by a slightly higher rate (of almost 5%), the difference being due to the gradually declining on-farm consumption in the EU. The quota abolition is expected to lead to a very modest reaction of EU-27 milk deliveries at the end of the quota regime in 2015[5].

[5] See Annex A1, Tables A1.1 till A1.5 for more outlook details on EU dairy product markets.



Source: DG-Agri

Figure 3.14 Milk production and deliveries and number of dairy cows in EU

The outlook appears favourable for higher value added dairy commodities, driven by growing demand for cheese and fresh dairy products.

- Production of fresh dairy products (including drinking milk, cream, yoghurts, etc.) is projected to increase by about 8% (from 2009 to 2020)
- Cheese output is depicted to grow by about 10%. Prospects for cheese exports are favourable despite the strengthening EUR, with the EU maintaining a steady share in global cheese exports above 30%.
- WMP production is expected to fall only marginally below its 2009 level and EU exports would remain firm over the medium term, driven by strong global demand. Nevertheless, the EU is expected to lose market share of global exports that would decline to 21% in 2020 (from 24% in 2009).
- The outlook for butter depicts continued market stability, conditional on firm domestic demand around the level of 2 mio t. The projected increase in production for 2015 (year of quota abolition) would lead to a temporary increase in EU exports.
- SMP export perspectives are less favourable given the assumed strengthening of the EUR and strong supply from other exporters. As EU demand prospects are also fairly weak, the outlook for price growth is rather constrained over most of the projection period. However, supply pressure on the market would be mitigated by reduced EU production.
- All in all, and despite the relatively favourable outlook and apparent short- and long term market stability for SMP, the nearer term prospects remain sensitive to global supply and demand developments and the market's ability to absorb the release of intervention stocks.

4. Dairy Developments in India

4.1 Introduction

Livestock is an important subsector of agriculture in India; it accounts for more than one fourth of agricultural gross domestic product (TE 2008-09); and provides employment to 21 million people, majority of whom are landless laborers, and marginal and small farmers. The livestock sector has been growing at faster rate than the crops sector and its contribution to agricultural economy has been increasing overtime. The milk and milk products is the major component of livestock sector and accounts for more than two third of the value of output of livestock products. The success of Indian dairy sector is well documented. Milk production in India increased from 17 million tonnes in 1950-51 to 116.2 million tonnes in 2010-11 and also per capita availability of milk increased from 124 grams per day to 263 grams per day during the above period. India emerged as the largest milk producing country in 1998 with 74.1 million tonnes overtaking USA and continued to maintain its crown. Among livestock commodities, milk and milk products are an important part of the Indian diet .The demand for milk and milk products has increased; their share in monthly per capita expenditure increased from 11.5 percent in 1983 to 14.9 percent in 2007-08 in rural areas and 15.7 percent to 18.4 percent in urban areas during the same period (GoI, 2010).

Looking at the evolution of Indian dairy, it is quite evident that the sector has undergone structural changes and there are some interesting patterns unfolding all along the value chain. Noteworthy are the changes in production of milk, livestock composition of population (increase in cross bred population), marketing of liquid milk pioneered by cooperative networks increase participation of private players. Despite breakthrough in production and increase in crossbred, high yielding species, productivity of milk producing animals is quite low. There is scope for enhancing the same through improved access to quality feed and fodder, veterinary and other health services. Also, milk processing is quite low; less than a quarter of liquid milk is being processed and a large part of the processing activities is undertaken by the unorganized or traditional sector. Available estimates suggest that nearly half of the milk produced is retained for household consumption, less than one fifth of the milk passes through organized players (cooperatives and private players) and more than two third is handled by the traditional sector. The challenge lies in overcoming the constraints that impede processing and value addition and also efficient marketing of milk and milk products. Of late, during much of 2009 and 2010, milk prices have increased and have been adding fuel to the overall food price inflation. The increase in price is not just driven by increase in demand for milk but also rising cost of production.

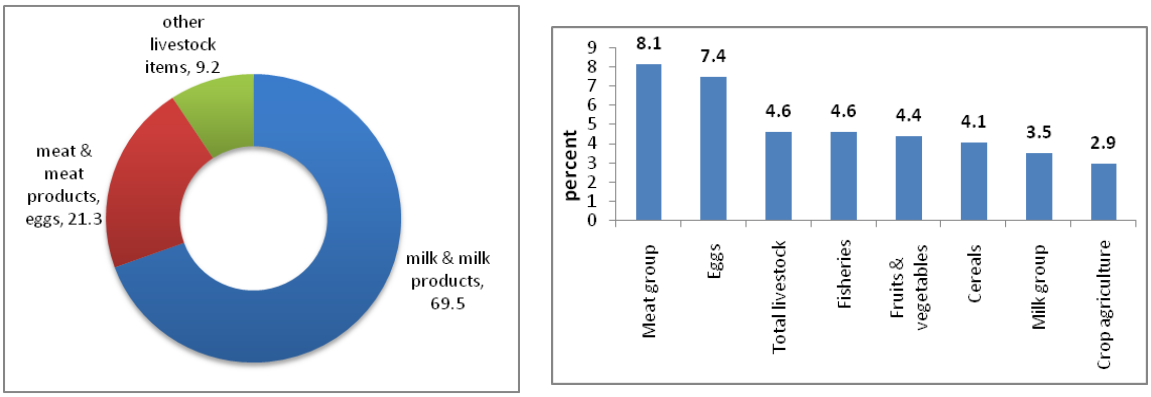
The success of the milk revolution in India is largely ascribed to the cooperative networks which were instrumental in linking the smallholder milk producer to the markets. However it must be noted that developing dairy cooperatives had the support of the government in funneling international assistance and also protecting the cooperatives against market competition. This approach helped in establishing the cooperatives and thereby securing the livelihoods of millions of milk producers across the country. With, several private players, big or small, domestic or multinational have come up and it is predicted that these players have already outnumbered the cooperatives and instill greater competition in the Indian milk market. Not all cooperatives to begin with is quite competitive and hence left to market forces, sustainability is an issue. However Given rising demand pressure, besides cooperatives, there is immense scope for expansion by the domestic as well as multinational players; through green field investments or joint ventures and partnerships. India can benefit from access to advanced technology and expertise that some of the large multinational players can bring in. The cooperative model driven by private zeal in developing milk value chains has the potential to ensure delivery of backend services, and forge better market linkages. Better integration can help farmers cut down their transaction costs, access better quality fodder and veterinary services, thereby increasing the net returns (Brithal, 2008; Kumar, 2010) from the trade point of view, while India has a huge domestic demand to meet, it has also been exporting to neighboring countries where food safety is not a big issue as is the case in developed countries.

4.1.1 Overview of the Indian Dairy Sector

Milk and milk products account for nearly 68 percent of the value of output of livestock in TE 2008-09 and its share hovered around 64 to 68% between 1950-51 and 2008-09. Value of output of

livestock has grown at a much faster rate at 4.6 percent compared to crop agriculture that has grown at 2.9 percent during TE 2008-09. Among livestock commodities, meat and meat products have grown the fastest at 8.1 percent followed by eggs at 7.4 percent and milk and milk products at 3.5 percent (Figure 4.1).

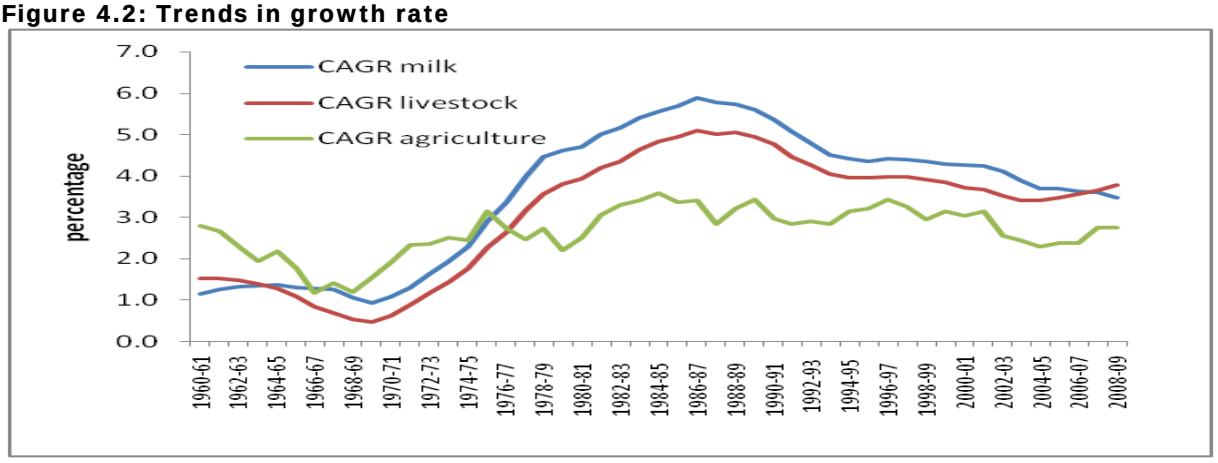
Figure 4.1: (a) Percent distribution of value of output of livestock by commodities. (b) Percent growth in value of output of crop, livestock and fisheries by value of output (TE 2008-09)



Source: NAS, CSO, GoI, 2010

Although the share of milk has increased slightly over a period of time; the growth has been somewhat fluctuating and in fact has declined from 5.4 percent in 1980s to 4.3 percent in 1990s and 3.5 percent in 2000s (Figure 4.2).

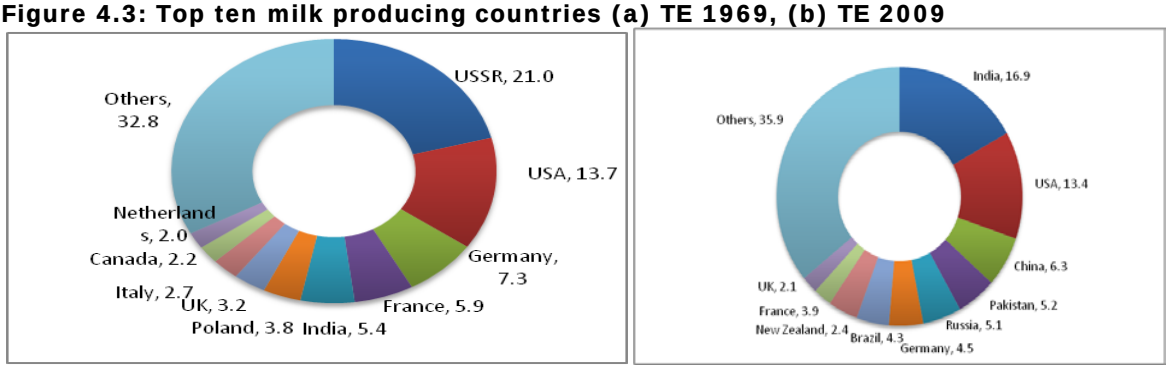
Figure 4.2: Trends in growth rate



Source: National account statistics, CSO and GoI, 2011
Note: CAGR; compound annual growth rate

With 116 million tonnes of milk, India is the chief manufacturer of milk followed by USA at 87 million tonnes in 2010. Milk production in China has boomed from 11.2 million tonnes in 1999 to 40.6 million tonnes in 2009; a significant increase in ten years. India accounts for almost 17 percent of global milk production in TE 2009, up from 5.4 percent in TE 1969 (Figure 4.3). The order of the top ten milk producing countries has also changed over time with Canada, Netherlands, Poland, and Italy giving way to China, Pakistan, and New Zealand. Comparing with EU(27), the countries together produce more than double the milk produced by India; led by Germany - 28.7 million tonnes; France - 24.2 million tonnes; United Kingdom - 13.2 million tonnes followed by Poland - 12.5 million tonnes and Italy - 12.8 million tonnes in 2009. As part of South Asia, India is the largest milk producing countries and accounts for more than 60 percent of milk produced in the region.

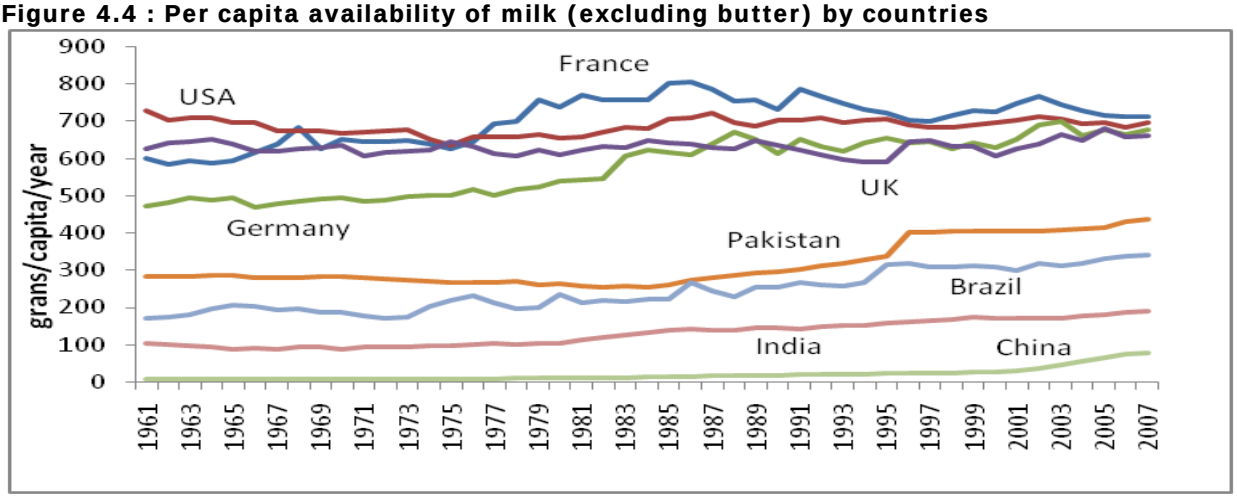
Figure 4.3: Top ten milk producing countries (a) TE 1969, (b) TE 2009



Source: FAOSTAT 2010| access date 12th December 2010

Although per capita availability of milk has increased, it is lower compared to the levels in other countries (Figure 4.4). Among the top milk producing countries, France has the highest per capita availability of milk – 713.6 grams per capita per day followed by USA, Germany and UK. India's per capita availability of milk as reported by FAO in 2007 was 188.3 grams per capita per day. However the data available from Indian database show that per capita availability of milk is 263 grams per capita per day in 2009-10.

Figure 4.4 : Per capita availability of milk (excluding butter) by countries



Source: FAOSTAT 2010| access date 12th December 2010

Note: Per capita availability of milk obtained from Indian database is higher than that reported by FAO, probably due to definitional differences. The data is used for country comparison

The demand for milk and milk products is projected to increase to 140 million tonnes by 2020, thereby exerting pressure on boosting supply response. While India already has a large population of livestock, raising productivity of the milk animals will be critical for meeting rising demand for milk and milk products. It is observed that demand for feed for animals will increase and will generate an increase in the indirect use of cereal commodities.

4.1.2 Beginning of a Structural Transformation In Milch Population

The efforts for systematic dairy development can be traced back to the British rule in 1862 when first veterinary school opened in Pune to meet the requirements of the veterinary and remount and veterinary corpse in the army. Subsequently the first military farm was set up at Allahabad to ensure supply of milk and butter to the colonial army. Some other efforts have also been made to augment the milk supply. This approach did not have perceptible impact on the supply of milk to the urban consumers. With the growth of urban population consumers had to depend on milk vendors who used to keep cattle in peri-urban areas and sell their milk, often door to door. Roya commission on agriculture in 1928 carried out a wide ranging study for dairy development on national scale and formulated few schemes with central Govt. backup the Polson model dairy at

Anand was established with the latest available technology and started manufacturing off sophisticated product like the famous butter. The first milk union the first Lucknow milk producers' cooperative union limited was established in 1937 followed by organization of such unions of other districts and states. In the post second world war period several private dairies having modernized processing facilities and came up in the city of Mumbai, Calcutta, Madras and Delhi and in some other large townships. However these early modern systems could neither bring any significant change in milk production, nor could they develop high yielding dairy quality animals. In the post-Independence Era, with the initiation of Indians first five year plan in 1951 modernization of the dairy industry became a priority for the government. During 1950s and 1960s various states government tried different strategies to develop dairying. However they could not implement a concrete plan during this period. The disappointing performance of the dairy sector during this period compiled policy makers and the government of India to undertake new policy. Initiatives in this direction dairy development through producers' cooperatives and milk production based on milk shades in the rural areas became mantra of the dairy development strategy. The strategy of dairy development through cooperative got further boost with the establishment of national dairy development board in 1965 and the subsequent efforts brought significant change in Indian dairy industry. In fact the structural transformation of the Indian dairy sector started with launching of operation flood in 1970. Operation Flood (OF) launched in 1970 ushered in the white revolution and was successful in bringing about a breakthrough in milk production and marketing across India. With the National Dairy Development Board was the execution-partner, the key objective of the program was to ensure that the country is able to meet its demand for milk and milk products by feeding the modern dairies set up in the metropolitan cities such as Mumbai, Delhi, Calcutta and Madras. The existence of large urban markets was instrumental in absorbing the milk produced in rural areas. The program was launched in three phases as discussed below:

Operation Flood Phase-I (1970-1981) was launched in Anand, Gujarat funded by World Food Program (WFP) which provided 126,000 tonnes of skim milk powder (SMP) and 42,000 tonnes of butter oil (BO) as aid. About Rs 1.2 billion was generated from the sale proceeds of SMP and BO and invested in implementation of this program. Four metropolitan cities were linked, viz., Bombay, Delhi, Calcutta, and Madras with a view to lay down modern milk industry in order to meet the demand of milk and milk products. Nearly 13,300 dairy cooperatives societies (DCS) in 39 milk sheds were formed and about 1.8 million farmers were registered as members pouring a peak of 3.4 million litres of milk per day and marketing of 2.8 million litres.

Operation Flood Phase-II (1981-1985) introduced a three tier model of cooperative comprising of milk societies, unions and federations. The project was approved by the government to be implemented during the sixth plan period with an outlay of Rs 2.7 billion. About US$ 150 million was provided by World Bank and European Economic Community (EEC) provided the balance in the form of commodity assistance. OF-II helped market milk to 148 cities and towns covering a population of 15 million. This involved 136 rural milk sheds comprising of 3.6 million farmers with 34,500 cooperative societies. Milk procurement increased to a level of 7.9 million litres per day and milk marketing to 5.0 million litres per day.

Operation Flood Phase-III (1985-1996) was funded by the World Bank with a credit loan of US$ 365 million, Rs 2.2 billion worth of food aid (75,000 tonnes of milk powder and 25,000 tonnes of butter/butter oil) by the EEC and Rs 2.1 billion by NDDB. By organizing 70,000 primary dairy cooperative societies, 170 milk sheds of the country were covered. OF - III focused on improving productivity by enhancing research and development in animal health and animal nutrition, availability of key inputs, training, monitoring and evaluation and market promotion. It also emphasized on institutional management issues of dairy cooperatives. Efforts were also put in to strengthen the national milk grid to ensure stable supply of milk to the consumers all through the year, and remunerative prices to the milk producers.

4.1.3 Scope of the National Dairy Development Plan

The success of operation flood during 1970-1996 insured the continuous growth in milk production. But the several regions of the country have been the success of operation flood was not uniform across state and regions. Some of the regions were by passed and the dairy sector remained underdeveloped in those regions. Intensive dairy development program was launched to develop dairy sector in these regions specially in the backward and hilly regions. Nevertheless there are significant variations in the dairy development. Further the cooperatives flourished under the protected regulatory environment, divide off competition from the private sector. The

economic reforms launched during 1990s change the rule of the game and created a conducive environment for participation of private sectors in Indian milk market. This led to a stiff competition between cooperatives and private sectors in some of the states. This sustainability of cooperatives along with vibrant private sectors is essential to protect the welfare of millions of scattered a smallholders dairy farmers. Besides accelerating growth in milk production and national perspective plan for dairy development was developed to achieve these objectives .The perspective plan has four thrust areas strengthening the cooperative business, enhancing productivity, managing quality, building a national information network.

After 14 years of operation flood from 1970-1996 the new operation flood is all set to launch in India in order to increase the milk production in next 10 years to meet up the upcoming demands of the milk by consumers. NDDB has planned to invest 17000 crore for the upcoming second white revolution for India in order to increase milk production by strengthening cooperatives, animals breeding health services, proper feeding to animals. As a part of 15year national plan milk production is expected to reach 180 million tonnes by 2021 first phase of the plan is scheduled from April 2011 to March 2017.Plan focuses on increasing the productivity through scientific breeding and feeding of animals. 66% of milk increase has been aimed in order to increase the production by 2021. 180 million of achievement has been targeted as compared to present milk production 110 million tonnes.

4.2 STRUCTURAL TRANSFORMATION IN MILCH POPULATION

4.2.1 Trends in Livestock Population

India has one of the world's largest population of different livestock species. In 2007, it had 199 million cattle, 105 million buffaloes, 141 million goats, 72 million sheep, 11 million pigs and 649 million poultry birds. In fact 57% of the world buffalo, 16% of the cattle and 17% of goats are reared in India. The cattle have always dominated the livestock production system in India. This is attributed to the crop livestock mixed farming system in the country, in which maintaining a sufficient number of cattle for use in crop production and transportation was the priority. However, the structure of livestock population has been changing overtime. In absolute terms the cattle population kept increasing till 1992, from 155 million in 1951 to 205 million in 1992 (Table 4.1). This trend was reversed during 1990s and between 1992 and 2003 the cattle population declined to 185 million; 9% decline was observed. However, this decline was attributed to the decline of indigenous stock particularly of male cattle. The decline in male cattle in turn is attributed to increasing mechanization of Indian agriculture, which reduced the role of animal draft power. The share of adult female cattle in total cattle stock increased from 29% in 1961 to 37% in 2007. The declining trend of cattle population however was reversed after 2003. Between 2003 and 2007, its population increased from 185 million to 199 million; registering an annual growth of about 2%.

Table 4.1: Trends in livestock population in India (Million heads)

Year	Cattle	Adult Female cattle	Buffaloes	Adult Female Buff-aloes	Total Cattle and Buffaloes	Sheep	Goat	Pig	Poultry
1951	155	54	43	21	199	39	47	4	74
1961	176	51	51	24	227	40	61	5	114
1972	178	53	57	29	236	40	68	7	139
1982	192	59	70	33	262	49	95	10	208
1992	205	64	84	44	289	49	96	11	307
2003	185	65	98	51	283	62	124	14	489
2007	199	73	105	54	304	72	141	11	649
					% Annual Growth				
1951-61	1.24	-0.64	1.67	1.47	1.33	0.3	2.6	1.7	4.5
1961-72	0.14	0.42	1.04	1.49	0.35	-0.1	0.9	2.6	1.8
1972-	0.77	1.04	1.97	1.29	1.08	2.0	3.5	3.9	4.1

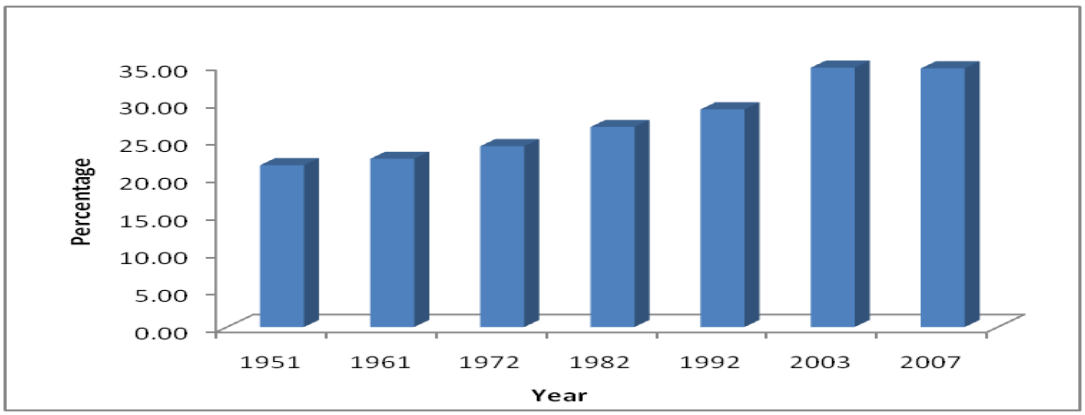
82									
1982-92	0.61	0.84	1.90	3.03	0.97	0.0	0.0	0.9	4.0
1992-03	-0.90	0.02	1.38	1.39	-0.19	2.3	2.7	2.0	4.8
2003-07	1.83	3.12	1.84	1.67	1.83	3.9	3.1	-4.7	7.3

Source: Livestock census (different years), BAHS, GOI

The disaggregated composition of livestock population shows that the increase in cattle population was registered both across sexes (male and female) and breeds (crossbred and indigenous). The maximum increase was observed in the crossbred cattle population, its population increased by 35 per cent in a short span of four years[6].

The population of buffaloes increased from 43.4 million in 1951 to 105 million in 2007. The buffalo population registered positive growth in all the decades. The annual growth of buffalo population kept fluctuating between 1 to 2 percent. The lowest growth in buffaloes population was observed during 1960s; 1.04% per annum. During 1970s and 1980s, the population of buffaloes grew by about 2% per annum. Buffaloes are reared mainly for milk production and the share of adult female buffalo accounted for 48 to 52% of total buffalo during different time periods. The share of buffalo in total bovines has increased from 22% in 1951 to about 35% in 2007 (see Figure 4.5). The proportionately higher increase of buffalo in total bovine population is due to relatively higher growth in buffalo than cattle. The changing composition of bovine population can be partly attributed to decreased, utility of indigenous cattle with increased mechanization, and the replacement of indigenous cattle with crossbred cattle. The other explanations for higher share of buffalo in bovine stock can be ascribed to the reduced mortality rate of buffalo calves because of its increasing demand in thriving buffalo meat export oriented industries. The increase in bovine population has many implications. The livestock density is already higher than the carrying capacity of natural resources in India. At the same time dairying is an integral part of mixed farming system and is important source of livelihood for several population of the country.

Figure 4.5: Share of buffaloes in bovine animals



Source: Livestock census, BAHS, GoI

There is a considerable regional variation in the spread of bovine animals (Appendix 2). Cattle have a wider spread, having a higher concentration in eastern region of the country. Buffaloes have a larger concentration in the irrigated northern plains, having sufficient supply of feeds and fodders.

4.2.2 Trends in Herd Size

[6] See Annex A2, Tables A2.1 and A2.2 for further details.

The macro dimensions of livestock population do not reveal whether the livestock assets at the grass root level has increased or decreased. Number of bovines per holding and per hectare given in (Table 4.2) indicates largely the changing herd size of the Indian dairy animals. The number of bovines per holding has declined from 3.2 in 1972 to 2.2 in 2003. It remained the same in 2007. However the number of bovines per hectare has increased from 1.4 in 1972 to 1.8 in 2007. Another dimension of changing structure of animal population is reflected in the consistent increase of in-milk animals in total number of bovines. Among bovines the share of in-milk animals was 12% in 1982: it increased to 25% in 2007. The increasing share of in-milk animals explicitly reflects the growing preference of farmers for rearing animals for milk production.

Table 4.2: Size of livestock holdings in India

Year	Number of operational holdings (million numbers)	No. of Bovines		(%) of in-milk animals
		Per holding	Per hectare	
1972	70.5	3.2	1.4	16.0
1982	81.6	3.1	1.5	11.8
1992	88.9	2.8	1.5	19.9
2003	120.8	2.2	1.7	24.4
2007	129.2	2.2	1.8	25.3

Source: NSSO report, Livestock census

4.2.3 Relationship between Herd and Farm Size

Indian milk production is dominated by marginal and small holders, together they account for about 80 per cent of total milk production in the country (Kumar *et al.*, 2008). The trends in bovine holding at household level will be helpful to understand the dynamics of dairy herd size across different categories of farming households. The numbers of bovines per holding and per hectare are given across different size of holdings. There exists a clear and direct relationship between the holding size and bovine per holding. It implies that large farmers are able to support higher number of bovines because of their higher resource base. However, there is an inverse relationship between the size of holdings and per hectare bovine. The livestock production system seems to be more intensified at the small holders. This also indicates that the role of milk production activities is critical to sustain the smaller land size farms. The higher intensification of bovine at smaller farms however poses challenges of allocation of meager land resource among crops and dairy production. The trade-off between the competitive uses of scarce land resources will be intensified with the increasing commercialization and intensification of Indian dairying. The synergy between milk production and crop production has to be maintained to ensure sustainable growth of this important sub-sector of Indian agricultural economy. The number of bovines per holding has decreased across all sizes of holdings except marginal holdings. (Table 4.3) The similar trend was observed in the number of bovines per hectare. The increase in livestock holding for the marginal farmers indicates the critical role of dairy animals for the sustenance of marginal holders.

Table 4.3: Size of livestock holding across different categories of farming households

Size of Holdings	No. of Bovine Animals			
	Per holdings(in ha)		Per hectare	
	1991-92	2002-03	1991-92	2002-03
Below 1.00	2.9	2.9	7.4	7.2
1.00 – 1.99	1.5	0.8	1.0	0.6
2.00 – 3.99	1.6	1.9	0.6	0.7
4.00 – 9.99	1.8	3.2	0.3	0.5
10.00 & above	2.2	2.3	0.1	0.1
All	2.4	2.4	1.5	1.8

Source: NSSO report

4.2.4 Regional Trends in Herd Size

The herd size shows distinct regional variations in India. The average herd size per holding in 2007 was the highest in Punjab (6.42), followed by Haryana (4.42), Orissa, Rajasthan, Gujarat, Madhya Pradesh, Himachal Pradesh and Assam are other states where average herd size was more than 3 (Appendix table A2.3). The trends in herd size also depicted a mixed picture. The herd size per ha increased in most of the states, it decreased per holding (Table 4.4)[7]. However, the issues of herd size needs to be interpreted cautiously, especially in terms of composition and milk productivity of animals.

Table 4.4: Distribution of states reported increase in herd size

Period	No. of bovines per holding	No. of bovines per ha
1972-82	Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh, Orissa, Punjab, Rajasthan, Uttar Pradesh, West Bengal	Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal
1982-92	Assam, Bihar, Jammu & Kashmir, West Bengal	Assam, Bihar, Gujarat, Haryana, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Uttar Pradesh, West Bengal
1992-2003	Haryana, Punjab and Uttar Pradesh	Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Rajasthan, Uttar Pradesh and West Bengal
2003-07	Andhra Pradesh, Assam, Gujarat, Jammu & Kashmir, Karnataka, Madhya Pradesh and Rajasthan	Andhra Pradesh, Assam, Bihar, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan

Source: NSSO, Livestock census

For instance, the dominance of low-producing non-descript animals contributed to the bigger herd size in states like Assam and Orissa, though these states are among the least dairy developed states of India. In a recent study based on field level data by Kumar *et al.* (2010) highlighted the extent of regional variation of herd size. The herd size in Punjab was double of that in Bihar (Kumar, 2008).

4.2.5 Adoption of Cross-breds

The introduction of high producing exotic germplasm has been conceived as an important strategy to improve productivity of indigenous stock. It was mooted in India in the early part of the 20th century, but could not become popular because of the fear of non–adaptability of crossbred animals to the tropical Indian conditions (Kumar *et al.*, 2003). However, during 1960s, concerted efforts were made to popularize crossbreeding program to meet the challenges of rising demand for milk. Since then crossbreeding program has become an integral part of the dairy development strategies in India. A number of crossbred strains such as Sunandini, Karan Swiss, Karan Fries and Frieswal, with a higher milk production capacity were developed.

Table 4.1: Trends in adoption of crossbred cattle

	Population crossbred (million no.)		% Share of crossbred in	
Year	Crossbred-total	Crossbred-female	Cattle	Female cattle
1982	8.8	4.8	4.6	5.3
1992	13.2	8.9	8.0	10.3
2003	24.7	19.7	16.0	22.9
2007	33.1	26.2	20.0	27.0
	Compound Annual Growth Rate (%)			
1982-92	6.3	5.4	5.7	6.9

[7] See Annex 2, Table A2.4 for further details.

1992-03	7.5	4.7	6.5	7.5
2003-07	7.3	7.6	5.7	4.2
1982-07	7.0	5.4	6.1	6.7

Source: Livestock census

Table 4.5 shows share of crossbred animals in India[8]. The National Commission on Agriculture estimated around 2 million crossbred cattle in the early 70s in the country, which kept increasing and now about 33 million of the cattle are crossbred, accounting for more than one-fifth of the total cattle. The population of crossbred cattle in fact increased four times during a period of about 25 years from 1982 to 2007. The crossbred cattle population has been increasing at an accelerating growth rate over time. The crossbred cattle population grew at an annual growth rate of 4% during 1982 to 1992, which accelerated to 6.5% per annum during 1992 to 2003. Between 2003 and 2007, the growth of crossbred cattle population further accelerated and registered an impressive growth of 8 per cent per annum. This accelerated growth of crossbred bovine altered the composition of cattle population (Table 4.6).

Table 4.2: Composition of in-milk animals

Year	No. of in-milk animals ('000)			
	Crossbred	Indigenous	Buffalo	Total bovine in milk
1982	1762	24827	17998	44587
1992	3341	24728	24685	52754
2003	8177	27626	33319	69122
2007	10716	30687	35643	77046
2009	11404	30881	36615	78900
	(%) share of different species/breeds			
1982	3.95	55.68	40.37	100.00
1992	6.33	46.87	46.79	100.00
2003	11.83	39.97	48.20	100.00
2007	13.91	39.83	46.26	100.00
2009	14.45	39.14	46.41	100.00

Source: BAHS (various issues)

In percentage terms, the share of crossbred in the total cattle population increased from 4.6% in 1982 to 20% in 2007. The objective of introducing crossbreeding program was to enhance the milk productivity of the indigenous cattle. Therefore, the adoption of crossbreds in female cattle is a better indicator to track the success of crossbreeding efforts. The adoption of crossbred in female cattle is even sharper.

4.2.6 Regional Trends

The share of crossbred in total female cattle rose from 5 per cent to 27 per cent during this period. The increased crossbred population is also reflected in the composition of in-milk animals. The share of crossbred in total in-milk animals increased from 4% in 1982 to about 15% in 2009. The adoption of crossbreeding technology is expected to further increase with greater commercial orientation of Indian dairy sector.

Table 4.3: Distribution of states according to adoption of crossbred female

Year	Adoption of cross-bred cattle (%)			
	> 50	25-50	10-25	<10

[8] See also Annex A2, Table A2.5 for more disaggregated data.

1982	Kerala	NA	Tamil Nadu, Haryana	J&K, Himachal Pradesh, Maharashtra, Karnataka, Andhra Pradesh, Bihar, Gujarat, West Bengal, Orissa, Uttar Pradesh, Rajasthan, Assam, Madhya Pradesh
1992	Punjab, Kerala	Tamil Nadu, J&K	Himachal Pradesh, Haryana, Maharashtra	Karnataka, Andhra Pradesh, Gujarat, West Bengal, Orissa, Uttar Pradesh, Rajasthan, Assam, Madhya Pradesh
2007	Kerala Punjab, Tamil Nadu, J&K	Himachal Pradesh, Haryana, Maharashtra, Karnataka, Andhra Pradesh	Bihar, Gujarat, Uttrakhand, West Bengal, Orissa, Uttar Pradesh	Rajasthan, Assam, Madhya Pradesh, Jharkhand, Chhattisgarh

Source: Livestock census

Regional differences in the spread of crossbreds are glaring (Table 4.8). In 1982, the crossbred accounted for more than 50% of total female cattle only in Kerala and in the majority of states the adoption of crossbred cattle was less than 10%. However, the situation changed overtime and the share of crossbred in total female cattle increased in all the states. In 2007, crossbreds account for over 90% of the total cattle in Kerala, 80% in Punjab, 71% in Tamil Nadu and 53% in J&K. Crossbreds account for 25 to 50 % in Haryana, Himachal Pradesh, Maharashtra, Karnataka and Andhra Pradesh, 10 to 25% in Bihar, Gujarat, Orissa, West Bengal, and Uttar Pradesh. In rest of the states, the crossbred accounted for less than cost of the total cattle population.

The delineation of states on the basis of level of adoption and growth of crossbred cattle suggest for different strategies. The states which have higher level of adoption and witnessing higher growth of crossbred cattle need less additional intervention. The continuance of on-going efforts will by and large ensure the wider adoption. The states which are having lower level of growth but are registering higher growth need more attention. The higher growth witnessed in these states indicate the potential of those states for enhancement of crossbred population. The recent initiatives which are accelerating the adoption must be strengthened. The states which have lower adoption and lower growth perhaps be analyzed thoroughly. It should be examined that whether those states need increase in crossbred and whether it is desirable to promote crossbreeding program in those states.

Table 4.4: Delineation of states on the basis of adoption and growth of crossbreds

Category	1982-1992	1992-2003	2003-2007
High adoption and High growth	Himachal Pradesh, Jammu & Kashmir, Tamil Nadu	Himachal Pradesh, Jammu & Kashmir, Tamil Nadu	Karnataka, Tamil Nadu
High adoption and Low growth	Haryana, Karnataka, Uttar Pradesh	Haryana, Maharashtra, Punjab, Uttar Pradesh	Haryana, Himachal Pradesh, Jammu & Kashmir, Punjab
Low adoption and High growth	Andhra Pradesh, Assam, Gujarat, Madhya Pradesh, Maharashtra, Orissa, Rajasthan	Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Rajasthan	Bihar, Gujarat, Madhya Pradesh, Orissa, Rajasthan, West Bengal
Low adoption and Low growth	West Bengal	Assam, Madhya Pradesh, Orissa, West Bengal	Assam, Uttar Pradesh

Source: Livestock census

4.3 STRUCTURAL TRANSFORMATION IN MILK PRODUCTION

4.3.1 Trends in Milk production

Increasing milk production has been a pre-eminent goal of India's dairy development efforts since independence. In pursuing this objective, the dairy development planning process in the country has been a fertile ground for devising interventions. The recent initiative of perspective National Dairy Development plan is the latest example. The Indian dairy industry has undergone significant changes and milk production has witnessed a quantum jump over time. Milk production in India has kept pace with the increase in its demand. It increased from 17 million tons (Mt) in 1950-51 to 116.4 Mt in 2010-11, an increase of almost seven- folds (Figure 4.6). However, during the two decades between 1951 and 1973, the growth rate in milk production was barely 1per cent per annum. A significant turnaround in Indian milk production was witnessed during the 1970s, when milk production grew at the rate of 4.5per cent per annum. The Operation Flood--a mega programme for increasing milk production was launched during this period. The growth in milk production accelerated further during the 1980s, when the annual growth in milk production reached to 5.41 per cent. The milk production in India grew at an annual growth rate of 4 per cent during the 1990s and at 3.8 per cent during first decade of the new millennium (Table 4.9). This high growth in milk production heralded the country into an era of self- sufficiency towards the late-1990s. The dependence on milk imports reduced considerably.

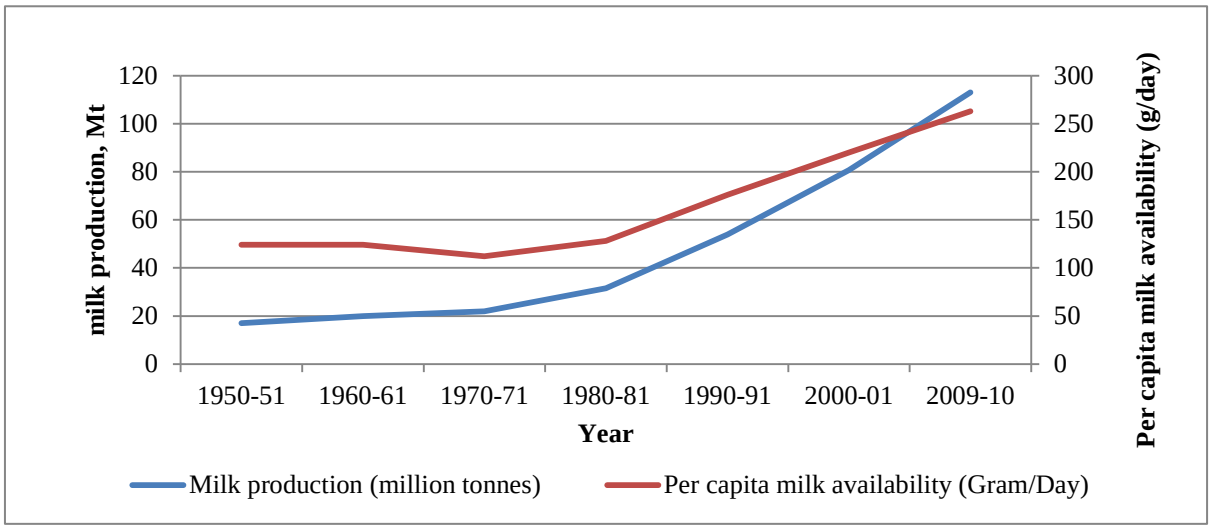
Table 4.9: Growth in milk production and milk availability in India

Year	Compound Annual Growth Rate (%)	
	Milk Production Growth Rate	Growth Rate of Milk availability
1950-1960	1.64	0.00
1960-1970	1.15	-0.78
1979-1981	4.51	1.93
1981-1990	5.41	3.25
1991-2000	4.28	2.46
2001-2010	3.81	1.99

Source: BAHS (various issues)

This has not only elevated India to the number one position of milk producer in the world, but also improved the availability of milk and milk products for the burgeoning population of the country.

Figure 4.6: Production and availability of milk in India



Source: BAHS (various issues)

In fact, with sustained increase in milk production, India became a net exporter of dairy products. Milk availability depends on the growth in milk production and rate of population growth. The milk availability remained stagnant or even declined during the first two decades after independence, viz. 1951 to 1973-74. The availability of milk picked up during the 1970s as the milk production started to grow at a fairly high rate. The milk availability increased from 110 g/day in 1973-73 to 176 g/day in 1990-91. It continued to increase and reached 263 gms per person per day in 2009-10.The substantial growth in the milk availability put India closer to achieving the world average of 285 g/day/person. However, the milk availability in India is still low as compared to most of the developed nations, but is high enough when compared across the developing countries.

4.3.2 Sources of Milk Production

In India, milk production in India is contributed largely by cattle and buffalo; they together contribute about 97% of milk production in India. The rest is contributed by goats. The milk production from crossbred has been growing at an impressive annual rate of about 8% during 1999-2000 to 2009-2010. Buffalo milk production has also registered a growth of 4 percent per annum. The milk production each from non-descriptive cattle and goat increased by 2 per cent per annum during this period. Because of the differential growth rate in milk production by different species and breeds, changes in the contribution of different species/breeds was observed. The changing structure of milk production clearly indicated the growing contribution of crossbreed cattle from 13% in 1992-93 to 23% in 2009-10. The share of cattle has slightly increased (from 42 to 43) and that of buffalo slightly declined. The share of goat has declined from 4.7% in 1999-2000 to 3.5% in 2009-10. Among cattle the share of crossbreed in milk production has been increasing consistently and during the last two decades its share in cattle milk production has increased from 31% in 1992-93 to 53% in 2009-10.

Table 4.10: Share of different livestock species in milk production across different states of India

(Percent)

State	1993-94			2009-10		
	Cattle	Buffalo	Goat	Cattle	Buffalo	Goat
Andhra Pradesh	28.8	71.2	0.0	27.1	72.9	0.0
Assam	83.0	13.5	3.6	84.1	13.0	2.9
Bihar	41.0	47.2	11.9	50.9	45.2	3.9
Gujarat	32.4	63.1	4.5	37.6	59.8	2.6
Haryana	17.7	80.3	2.0	15.4	83.6	1.0
Himachal Pradesh	44.8	51.2	4.0	61.4	35.9	2.8
Jammu & Kashmir	66.0	29.4	4.6			
Karnataka	53.4	46.1	0.5	67.7	31.2	1.1
Kerala	89.0	5.5	5.5	93.3	1.7	5.0
Madhya Pradesh	41.5	51.1	7.5	44.1	50.2	5.7
Maharashtra	49.7	45.5	4.8	52.6	43.7	3.7
Orissa	80.2	19.5	0.4	86.3	13.5	0.2
Punjab	27.3	71.9	0.7	32.2	67.3	0.5
Rajasthan	37.0	52.2	10.8	28.3	61.2	10.5
Tamil Nadu	59.6	40.4	0.0	86.8	13.2	0.0
Uttar Pradesh	27.7	66.4	5.9	26.6	68.0	5.4
West Bengal	91.3	8.4	0.3	91.9	5.0	3.1
All India	41.9	53.7	4.4	43.1	53.4	3.5

Source: BAHS (various issues).

With the gradual replacement of non-descriptive cattle with improved crossbred, contribution of crossbred in future milk production is certainly going to increase further. The contribution of different livestock breeds/species in milk production varies widely across states. In 2009-10, the

share of cattle varied from 15.4 per cent in Haryana to 91.9 per cent in West Bengal (Table 4.10)[9]. The contribution of cattle in state milk production is more important in Assam (83%), Kerala (89%), Jammu & Kashmir (66%), Karnataka (53%), Orissa (80%), and Tamil Nadu (60%). Buffalo is more important for milk production in the northern states besides Andhra Pradesh. Its contribution to state milk production varies from 8.4 per cent in West Bengal to 80 per cent in Haryana. The contribution of buffalo is about three-fourths to the state milk production in Andhra Pradesh (71%) and Punjab (72%) and more than half in Uttar Pradesh (66.4%), Gujarat (63%), Rajasthan (52%), Himachal Pradesh (51%), and Madhya Pradesh (51%). In cattle milk production, increase in the share of cross-bred species has been observed in all the states, though with varying magnitudes. The contribution of goat in milk production has been highest in Rajasthan (10.5%), followed by Madhya Pradesh (5.7%), Uttar Pradesh (5.4%), Kerala (5.0%), Bihar (3.9%), Maharashtra (3.7%), West Bengal (3.1%), Assam (2.9%), Himachal Pradesh (2.8%) and Gujarat (2.6%) in 2009-10. In other states, its contribution in state milk production is negligible.

4.3.3 Regional Trends in Milk Production

There are significant regional variations in the structure of dairying that affect production and productivity of milk. In 2009-10, Uttar Pradesh with milk production of 21.6 Mt was the largest milk producing state (19.2%) in India. It is producing more milk than even the countries like New Zealand, Australia, Ukraine, and Turkey. Andhra Pradesh (9.3%), Rajasthan (8.5%), Punjab (8.3%), and Gujarat (7.9%) Maharashtra (6.8%), Bihar (6.7%). Haryana (5.3%), Karnataka (4.3%) and West Bengal (3.8%) are other significant milk-producing states in India (Table 4.11).

Table 4.11: Trends in milk production across states of India

State	Milk production ('000 tonnes)		Share of different states in national milk production (%)	
	1992-93	2009-10	1992-93	2009- 10
Andhra Pradesh	3103	10429	5.35	9.27
Assam	658	756	1.14	0.67
Bihar	3195	7587	5.51	6.74
Gujarat	3795	8844	6.55	7.86
Haryana	3715	6006	6.41	5.34
Himachal Pradesh	610	836	1.05	0.74
Jammu & Kashmir	937	1604	1.62	1.43
Karnataka	2590	4822	4.47	4.28
Kerala	1889	2537	3.26	2.25
Madhya Pradesh	4879	8123	8.42	7.22
Maharashtra	4102	7679	7.08	6.82
Orissa	542	1651	0.94	1.47
Punjab	5583	9389	9.63	8.34
Rajasthan	4586	9548	7.91	8.48
Tamil Nadu	3468	5778	5.98	5.13
Uttar Pradesh	10649	21580	18.37	19.18
West Bengal	3023	4300	5.22	3.82
India	57962	112540	100	100

Source: BAHS (various issues).

The share of Andhra Pradesh, Bihar, Gujarat, Rajasthan and Uttar Pradesh in national milk production has increased over time. The increased share of these states in total milk production of the country can be attributed to the higher growth of milk production witnessed in these states as compared to in other states.

[9] See Annex A2, Tables A2.6 and A2.7 for further details.

The disaggregated growth of milk production across states depicted a diverse trend (Table 4.12). During 1992-93 to 2009-10, the growth in milk production was very impressive in Orissa (7.4%), Andhra Pradesh (6.6%), and Bihar (6.0%). The state of Gujarat, Jammu & Kashmir, Rajasthan, and Uttar Pradesh also recorded more than 4 per cent annual growth in milk production.

Table 4.12: Compound annual growth rates of milk production across different states of India
(percent per annum)

State	1992-93 to 1999-00	2000-01 to 2009-10	1992-93 to 2009-10
Andhra Pradesh	6.12	7.01	6.61
Assam	0.43	1.24	0.45
Bihar	1.25	10.86	6.00
Gujarat	4.74	5.55	4.84
Haryana	3.23	2.04	2.64
Himachal Pradesh	2.57	1.75	2.10
Jammu & Kashmir	7.21	1.92	4.11
Karnataka	8.59	-0.04	2.76
Kerala	4.02	-0.79	0.57
Madhya Pradesh	1.83	4.14	3.06
Maharashtra	4.82	3.00	3.48
Orissa	6.09	8.43	7.42
Pondicherry	3.88	3.06	2.59
Punjab	4.63	2.34	3.07
Rajasthan	7.08	3.17	4.55
Tamil Nadu	3.95	2.40	3.14
Uttar Pradesh	4.26	4.16	4.41
West Bengal	1.98	2.47	1.86
All India	4.38	3.83	3.89

Source: BAHS (various issues)

The period-wise trends in milk production are more revealing. In many states, the growth in milk production accelerated during the period 2000-01 to 2009-10 than during 1992-93 to 1999-00. These states included Andhra Pradesh, Assam, Bihar, Gujarat, Madhya Pradesh, Orissa and West Bengal. Growth of milk production in Bihar (10.86%) and Orissa (8.43%) were outstanding. The acceleration in these states must be maintained to ensure high and sustainable growth of milk production in India. The trend in growth in milk production suggests that the development of dairying sector is becoming wide spread and its contribution in providing livelihood is increasing with time. The recent growth witnessed in Bihar and Orissa reveals their potential for dairy development. The adequate provision of support services in terms of infrastructure, marketing, credit, etc. should be ensured to maintain their promising trends in milk production.

4.3.4 Milk Productivity

Indian milch animals are low producing. Productivity of cattle in terms of milk yield is about half of the global average. The milk yield varies across breeds and species and also across states. As expected buffaloes have higher productivity as compared to indigenous cows but crossbred cows score over both in milk yield. The milk yield of crossbred cattle, buffalo and non-descript cattle at national level were 6.9 kg/day, 4.6 kg/day and 2.1 kg/day respectively. The regional differences in milk productivity are glaring (Table 4.13). The productivity of all milch animals (cattle and buffalo) was the highest in Punjab, followed by Haryana. Milk productivity of milch animals was lowest in Assam. The milk yield is also lower in states like Bihar, Orissa, and West Bengal etc. The regional differences in milk productivity can be attributed to several factors. The distribution of breedable bovine population differs significantly in different states of the country.

The productivity of milch animals in 2009-10 (cattle and buffalo) was highest in Punjab (8.9 kg/day), followed by Kerala (7.6 kg/day) and Haryana (6.5Kg/day). Milk productivity of milch animals was lowest in Assam (1.3 kg/day). Milk yield in Himachal Pradesh, Madhya Pradesh, Orissa and West Bengal was less than 3 kg/day in 2009-10. The milk yield in the remaining states was in the range of 3 to 5 kg per day. However, the productivity of all the milch animals has increased over time. The growth in milk productivity between 1992-93 and 2009-10 was impressive in Orissa (6.64%), Andhra Pradesh (4.13%), Kerela (4.06%) and Tamil Nadu (3.21%). The growth in milk yield was almost stagnant in Assam and West Bengal. The growth rate of milk productivity was more than 2 per cent in Karnataka, Maharashtra, Punjab and Rajasthan.

Table 4.13: Productivity of animals in-milk across states[10]

States	Milk yield (kg/day)		Growth rate (% per annum)		
	1992-93	2009-10	1992-93 to 1999-00	2000-01 to 2009-10	1992-93 to 2009-10
Andhra Pradesh	1.87	3.80	5.70	3.03	4.13
Assam	1.16	1.27	0.18	0.56	0.25
Bihar	2.58	3.42	1.27	0.52	1.27
Gujarat	3.47	4.63	1.20	2.67	1.63
Haryana	5.06	6.54	1.72	1.37	1.34
Himachal Pradesh	2.39	2.99	1.43	0.46	1.08
Jammu & Kashmir	2.81	4.51	3.05	3.07	3.01
Karnataka	2.11	3.22	4.76	0.33	2.31
Kerala	3.89	7.59	5.82	3.01	4.06
Madhya Pradesh	1.70	2.69	4.11	1.49	1.62
Maharashtra	2.50	3.62	1.89	1.87	2.74
Orissa	0. 73	2.06	5.62	7.55	6.64
Punjab	5.83	8.88	1.77	3.26	2.16
Rajasthan	3.34	4.99	0.92	4.14	2.20
Tamil Nadu	3.07	5.13	3.33	3.49	3.21
Uttar Pradesh	3.00	3.93	2.10	1.06	1.76
West Bengal	2.24	2.76	3.57	0.72	1.67
All India	2.71	3.94	2.83	1.93	2.10

*includes crossbred
Source: BAHS (various issues)

The regional differences in milk productivity can be attributed to several factors. The distribution of breedable bovine population differs significantly in different states of the country. There have been wide differences in the resource base for feed, fodder, animal healthcare, artificial insemination facilities, etc. across states. These factors are instrumental to a large extent in creating regional disparities in production and productivity of milk across different states. Cow milk yield has grown in most of the states faster than that of buffalo. The growth however decelerated subsequently which is a cause of concern.

4.3.5 Participation of Small Holders in Milk Production

India's dairy industry is largely traditional, local and informal. Milk production is dominated by smallholders, including landless agricultural workers. About 80% of raw milk comes from farms having only 2 to 5 cows/buffaloes. The contribution of different categories of farmers to the national milk production is anecdotal. An idea about the contribution of smallholders in milk production in India can he had from the analysis of household level information of the 59th round of the national sample survey organization (GOI 2005). Using these data we have examined the

[10] See also Annex A2, Tables A2.10 and A2.11 for more disaggregated data.

participation of marginal and small farmers in the dairying activities and their share in national milk production. It is evident from Table 4.14 that 78% of milk producers are marginal and small farmers and they together contribute around 68% to total milk production. This trend holds true more or less across all the states.

Table 4.14: Contribution of marginal and smallholders in milk production

States	Share of marginal and smallholders (%)	
	Milk Production	Milk-producing households
Andhra Pradesh	63.2	68.6
Assam	84.7	85.2
Bihar	84.3	89.8
Chhattisgarh	52.9	65.0
Gujarat	69.7	75.2
Haryana	68	73.7
Himachal Pradesh	89.9	91.1
J&K	88.9	90.0
Jharkhand	67.4	89.4
Karnataka	64.4	62.7
Kerala	83.5	92.5
Maharashtra	51.8	59.5
Madhya Pradesh	51.2	57.9
Orissa	88.7	89.2
Punjab	51.0	73.4
Rajasthan	46.5	60.3
Tamil Nadu	75.9	81.3
Uttar Pradesh	77.2	86.2
Uttarakhand	95.1	95.8
West Bengal	92.9	95.5
North-Eastern Regions	92.8	96.1
Union Territories	82.2	90.7
All India	68.8	77.4

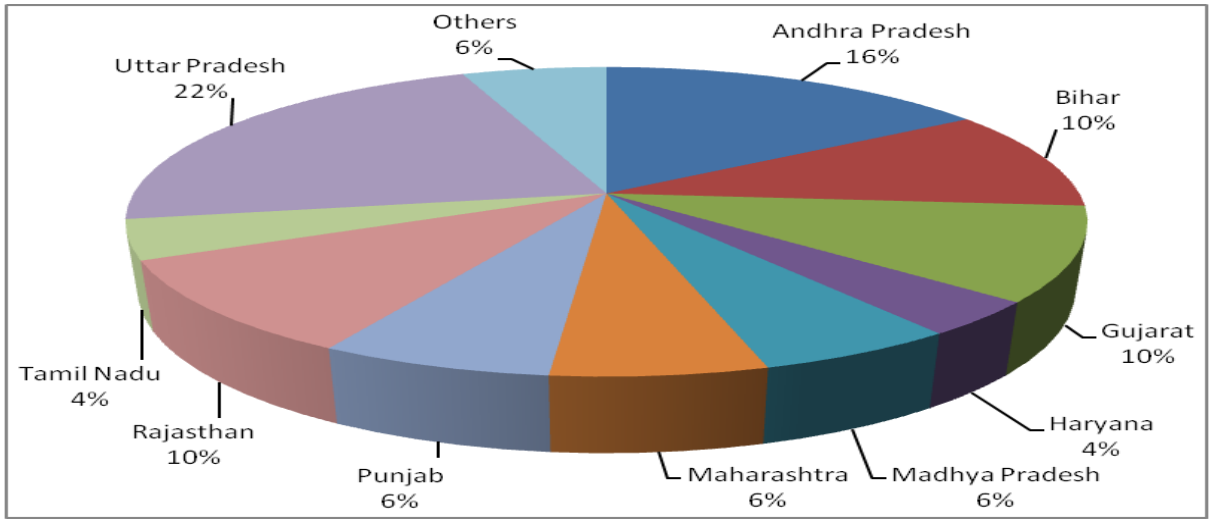
Source: Kumar et al (2010)

In some of the states like Bihar, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Orissa, Tamil Nadu, Uttrakhand and West Bengal. Marginal and Small farmers constitute about 90% or above the total milk producing households. And they contribute more than 85% to the total milk production in these states. These small farmers traditionally do not have access to organized markets. The major reasons behind this have been lack of an effective system to procure milk produced in the rural areas, and the perishable nature of milk; these make it difficult and expensive to transport milk. In response to the limitations of this system, efforts have been made to promote organized milk marketing in the country and several policy initiatives have been taken to develop formal milk marketing and processing institutions in the country.

4.3.6 Sources of Growth in Milk Production

The impressive growth of milk production has been a matter of intense debate in India. The critics of the Indian dairy development strategies argue that the growth in milk production is regionally concentrated number led and devoid of technological breakthrough. The empirical evidence on sources of growth would address some of these concerns. The contribution of different states in milk production between 1992-93 and 2009-10 are shown in Figure 4.7.

Figure 4.7: Contribution of different states in the growth of milk production in India



Source: BAHS2010

The milk production in India almost doubled during this period from about 58 million tonnes to 112 million tonnes. Uttar Pradesh alone accounted for 22 % growth in national milk production. Andhra Pradesh contributed around 17% production Bihar, Gujarat and Rajasthan each contributed about 10% of the annual growth rate of total milk production in the country. These five states together contributed about 68% of the annual growth of milk production during this period. Rest of the growth was contributed by other states. Madhya Pradesh, Maharashtra and Punjab were other states which contributed significantly to the growth of milk production.

4.3.7 Contribution of Different States in Milk Growth

The contribution of different states in incremental milk production between 1992-93 and 2009-10 is shown in Table 4.15. The milk production in India almost doubled during this period, from about 58 Mt to 112 Mt. Uttar Pradesh alone accounted for more than 20 per cent of the incremental growth in national milk production. It was followed by Andhra Pradesh with a contribution of over 13 per cent increase in milk production. The states of Gujarat (9.3%), Rajasthan (9.1%), Bihar (8.1%) and Punjab (7.0%) have also contributed significantly to the additional milk production in the country during this two-decade period. These six states together contributed about 66 per cent to the additional milk production in the country. Madhya Pradesh, Maharashtra and Punjab were the other states which contributed to the growth of milk production. The temporal trends in the contribution of different states depicted the increasing role of some new states as the emerging sources of national milk production. Besides, Andhra Pradesh, Gujarat and Uttar Pradesh during 2000 to 2009, the contribution of Bihar, Orissa, Madhya Pradesh and West Bengal in the incremental milk production has increased over time.

Table 4.15: Contribution of different states in the growth of milk production in India (Per cent)

State	1992-99	2000-09	1992-2009
Andhra Pradesh	9.93	15.37	13.42
Assam	0.04	0.23	0.18
Bihar	1.27	13.11	8.05
Gujarat	7.25	11.06	9.25
Haryana	4.74	3.62	4.20
Himachal Pradesh	0.65	0.23	0.41
Jammu & Kashmir	1.72	0.89	1.22

Karnataka	9.26	0.70	4.09
Kerala	3.16	-0.21	1.19
Madhya Pradesh	3.15	8.10	5.94
Maharashtra	7.90	5.73	6.55
Orissa	1.52	2.43	2.03
Punjab	10.45	5.05	6.97
Rajasthan	13.26	6.55	9.09
Tamil Nadu	5.50	2.72	4.23
Uttar Pradesh	17.24	20.98	20.03
West Bengal	2.17	2.60	2.34
Others states	0.80	0.85	0.79

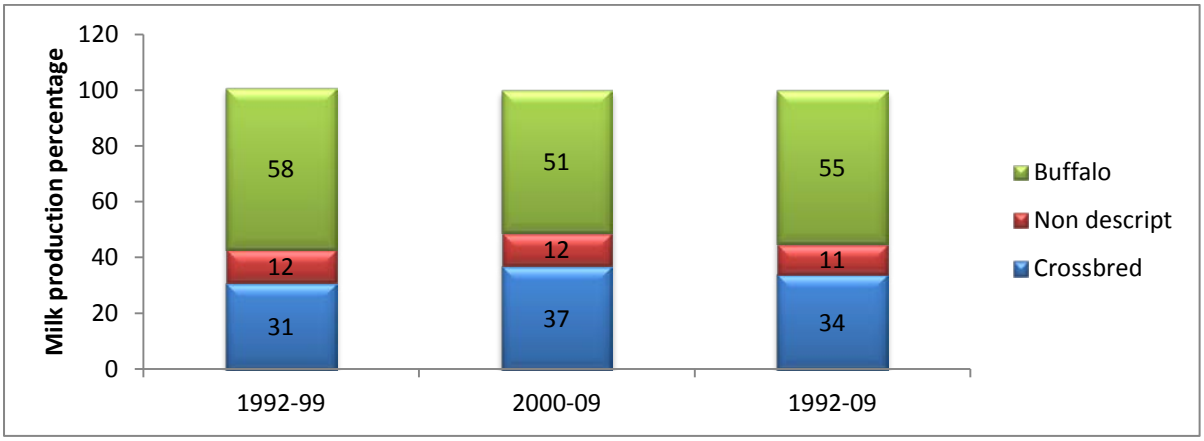
Source: BAHS (various issues).

4.3.8 Contribution of Population and Productivity in Milk Growth

Another dimension of looking at the sources of growth is to assess the contribution of population and breed of livestock to the incremental milk production. Between 1992 and 2010, 56 per cent of the incremental production was contributed by increase in milk productivity and 43 per cent by the increase in population of milch animals. The remaining 1 per cent was contributed by the effect of interaction between population and productivity of milch animals. During the period 1992-2009, the crossbred cows accounted for 34 per cent of the additional milk production and 14 per cent of this came from improvement in their milk productivity (Figure 4.8 & 4.9). On the other hand, indigenous cows contributed 11 per cent to the incremental milk production and about 80 per cent of it came from enhanced milk productivity. Buffalo accounted for 55 per cent of the augmented milk production and improvement in yield contributed 41 per cent to it this. These results indicate that the growth in milk production has come largely from replacement of low-yielding indigenous cows with crossbreds and buffaloes.

The contribution of productivity to output growth is a combined effect of technology and improvements in feed, healthcare and other management practices. In the case of crossbred/improved animals, milk productivity is embodied as a general trait and therefore, the contribution of the crossbred/improved animals to incremental milk production may be attributed to the contribution of technological change. The potential of crossbred cattle and buffaloes is yet to be exploited and efforts should be made to bridge the yield gap. Better management of higher milk yielding breeds of indigenous cows such as Sahiwal, Gir, and Tharparkar can further increase the rate of growth in milk production. The improved indigenous breeds have yield potential of around 2000 kg per annum.

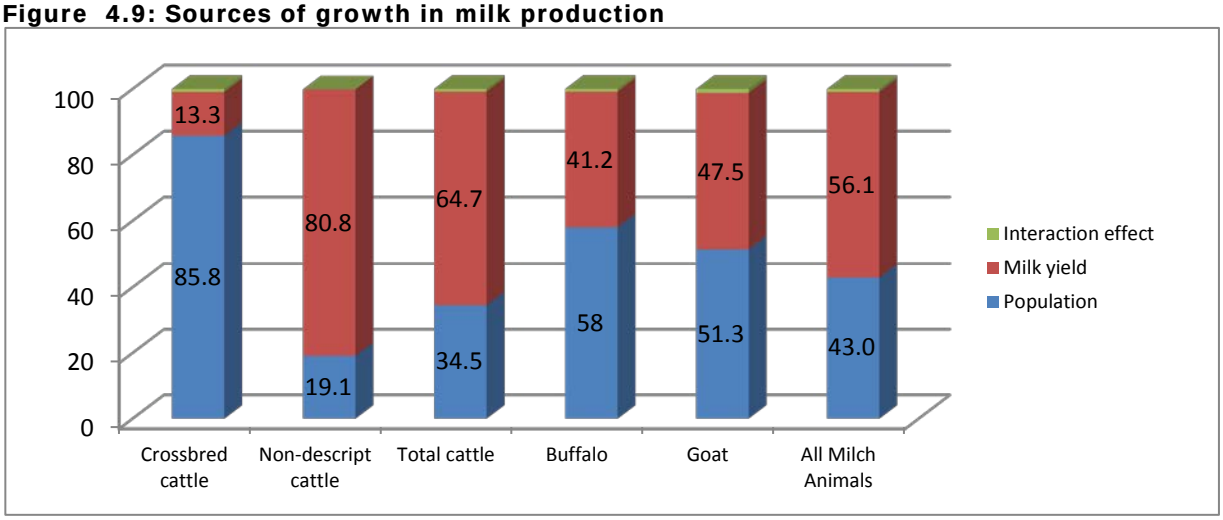
Figure 4.8: Contribution of different species to increase in milk production



Source: Livestock Census[11]

The rapid growth in production and productivity of dairy animals could be attributed to adoption of technological change, better feeding and improvement in animal healthcare facilities. Kumar and Pandey (1999) have estimated the total factor productivity (TFP) growth in the livestock sector for the period 1951 to1995-96 and have found that the total factor productivity grew at an accelerated rate after 1970-71 (1.4%/year) compared to the pre-1970-71 period growth of -0.4 per cent per year. During the post-1970-71 period, the TFP growth accounted for nearly 40 per cent of the output growth in the livestock sector.

Figure 4.9: Sources of growth in milk production



Source: Livestock Census

4.3.9 Determinants of Milk Productivity

Irrespective of whether the past growth has been driven by livestock numbers or productivity, the enhancement in milk yield is critical to ensure a sustainable growth in milk production in the long-run. The results of regression analysis providing the effect of selected variables like herd size, adoption of crossbred species, veterinary facilities, availability of fodder, literacy level, etc. have been presented in Table 4.16. All the variables included in the model, by and large, have been found statistically significant and have expected plausible signs. The strongest impact has been of the presence of veterinary institutions and milk marketing co-operatives. The lack of adequate organized marketing and veterinary services have been cited as the major constraints in enhancing milk productivity in India. The significant positive relationship between herd size and milk yield indicates that the dairying is not always scale-neutral. The bigger herd size induces the farmers for adoption of better management practices.

The crossbred cattle have emerged as the hope of future for increasing milk production in India. Similarly, buffalo is considered to be an efficient converter of low-grade fibrous feed into high-value milk. The positive association between milk yield and share of crossbred and buffalo in the total milch population re-affirmed its important role in increasing the milk yield of Indian milch animals. The positive relationship between area under irrigation and milk yield suggests that the developments in the crop sector are crucial for dairy development. The analysis has indicated that irrigation, through increasing year-round availability of fodder, is one of the main driving factors for enhancing milk yield in India.

Table 4.16: Regression coefficients for determinants of milk productivity

Dependent variable: Milk yield per animal per day				
	Equation 1		Equation 2	
Explanatory variable	Coefficient	Standard error	Coefficient	Standard error

[11] See also Annex A2, Tables A2.8 and A2.9 for further details.

Share of cross-bred in milch animal (%)	0.0449***	0.0033	0.0468***	0.0024
Share of buffalo in milch animal (%)	0.0401***	0.0027	0.0379***	0.0020
Herd size (No.)	-0.0069	0.0217	0.0237**	0.0113
Literacy rate (%)	0.0204***	0.0056	0.0164***	0.0040
Irrigated area (%)	0.0164***	0.0022	0.0155***	0.0019
Dairy co-operative societies (No. per' 000 bovine units)	0.1723*	0.0961		
Veterinary institutions (No. per' 000 bovine units)			0.1806***	0.0387
Constant	-0.8849	0.3598	-0.5193	0.2291
No of observations	263		352	
R^2	0.8081		0.8319	

***Significant at 1 per cent level, ** Significant at 5 per cent level, * Significant at 10 per cent level.
Source: BAHS (different years) Livestock Census, Agricultural Statistics at a Glance, Population Census, GoI.

Literacy helps the dairy farmers in several ways. Appropriate education and capacity development enable them to take advantage of emerging technologies and thus help in raising milk productivity. A significant positive association between milk productivity and literacy suggests that the education plays an important role in increasing milk yield, indicating for greater emphasis on human resource development for technology-led development of the Indian dairy sector. Similar findings have been reported by Birthal et al. (1999) and Chand and Raju (2008).

4.3.10 Growth in Factors of Milk Productivity

The growth rate in number of crossbred cows increased slightly from 6.3 per cent during 1980-81 to 1992-93 to 6.7 per cent during 1993-94 to 2009-10 (Table 4.17). The membership of dairy co-operatives increased annually by 14 per cent in the first period 1980-1992 but the growth rate declined to mere 3.0 per cent during the second period 1993-2009. There was a fast acceleration in the growth rate of artificial inseminations (AIs) performed. The annual growth rate in AIs performed was 3.1 per cent in first period and 5.8 per cent in the second period. The growth rate in the number of veterinary institutions and veterinarians decelerated in the second period. The number of veterinary institutions grew annually by 6.4 per cent during 1980-81 to 1992-93 but only by 0.9 per cent during 1993-94 to 2009-10. The growth rate in number of veterinarians reduced from 6.3 per cent in the first period to 2.8 per cent during the second period.

Table 4.17: Annual growth rate in factors associated with milk yield

(percent)

Particulars	1980-92	1993-09
Cross-bred cows	6.32	6.74
Buffaloes	2.34	1.97
Membership of dairy co-operative society	14.06	3.01
Herd size (No./household)	-1.87	-0.49
Artificial insemination performed	3.09	5.76
No. of veterinary institutes	6.37	0.90
No. of veterinarians	6.33	2.75
Fodder area (ha)	0.05	-0.12
Irrigated area (%)	2.06	1.32
Literacy rate (%)	1.86	1.70

Source: Basic Data from BAHS (different years), Livestock Census, Land Use Statistics, Agricultural Statistics at a Glance, Population Census, GoI.

The rate of decline in herd size slowed down in the second period to 0.5 per cent from 1.9 per cent in the first period. The area under fodder witnessed almost stagnation in both the periods. The growth rate in the irrigated area also decelerated from 2.1 per cent in the first period to 1.3 per

cent in the second period. The growth rate in literacy was about 1.9 per cent in the first period and it slightly declined to 1.7 per cent in the second period.

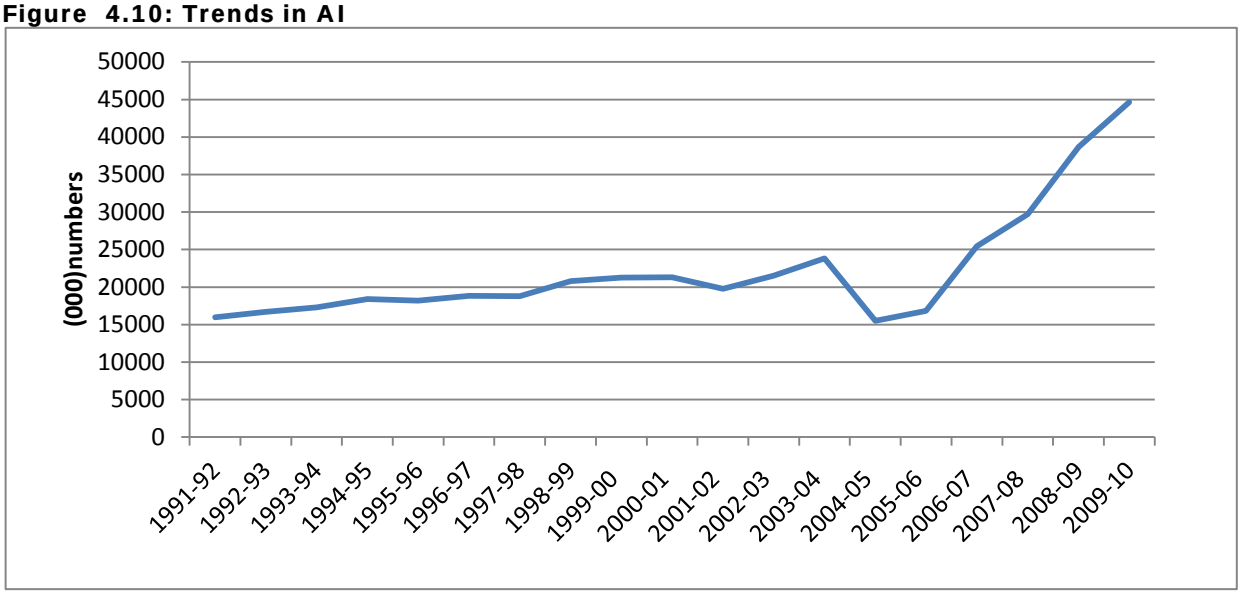
4.4 EVOLUTION OF DAIRY SERVICES: ROLE OF AI AND OTHER VETERINARY SERVICES

An array of support services is required for harnessing the potential of milk production in India. The role of breeding and animal health services is the most critical factor for sustainable dairy development. These support systems have evolved overtime and still going through the evolutionary process in India. A brief accounts of progress of artificial insemination (AI) is given in the following sections.

4.4.1 Growth in AI Services

The introduction of exotic breeds and crossing them with local breeds have been conceived as one of the most important strategy for breed improvement. in India. Efforts for providing breeding services started off during the pre-independence period. Initially improved bulls were distributed for natural service in the crossbreeding strategy. This approach was later replaced by artificial insemination (AI) which has become the main focus of infrastructural development for breed improvement. AI is a process of placing sperm into the reproductive tract of a female for the purpose of impregnating the female instead of sexual intercourse. In 1938-39 there were 53 cattle breeding farms in northern part. The efforts for popularizing cross-breeding through AIs gained momentum only after independence. During the first five year plan the main instrument for cattle development was the key village scheme (KVS) with a focus on setting up bull breeding farms and artificial insemination centres in major cattle tracts. Later KVS got merged with integrated cattle development program (ICDP) and the emphasis of breeding services centered around establishment of AI centers, frozen semen stations and other related infrastructure for facilitating crossbreeding program. Growth of AI centers in India has been rapid. The number of AI centres increased from about 4000 during the 1970s to nearly 7000 in 2010. The increase in the AI centers led to the substantial increase in the delivery of AI services. The number of AIs performed has increased tremendously; it increased from 16 million in 1991-92 to 44.6 million in 2009-10. (Figure 4.10)

Figure 4.10: Trends in AI



Source: NDDB, BAHS 2010

4.4.2 Regional Trends

The AIs carried out in different states depicted an increasing trend in almost all states (Table 4.18). The rate of growth in AIs during 1990-91 to 2009-10 was the highest in Gujarat(12.4%), followed by Punjab (10.1%), Madhya Pradesh (9.8%),West Bengal(8.5%) and Karnataka's (7.9%).The reasonably high growth rates in AIs observed in majority of the states indicate that AIs are gaining wide spread popularity and replacing the natural services steadily. These growth

trends indicate that AI service centers have spread across the country. However, in spite of the tremendous growth of the AI centers and delivery of AI services, the facilities are still far from adequate in relation to the size of the adult milch animal population.

Further, regional concentration of AI centers is constraining the uniform a spread of this effective mechanism of breed improvement. AI centers are concentrated only in few states. More than one third of the AI service centers are located in Andhra Pradesh, Karnataka, Tamil Nadu and Kerala; these four states together account for not more than about 18 to 19 % of breedable bovine population.

Table 4.18: Trends in artificial inseminations

State	Artificial insemination ('000 no.)			Growth rate (% per annum)		
	1991-92	2001-02	2009-10	1991-92 to 2000-01	2001-02 to 2009-10	1991-92 to 2009-10
Andhra Pradesh	1564	2670	5039	5.25	7.87	6.78
Assam	127	91	204	-11.11	9.38	6.24
Bihar	828	26	950	-	55.46	-
Gujarat	501	645	5167	2.94	33.27	12.41
Haryana	713	802	2043	-4.20	13.85	7.18
Himachal Pradesh	263	394	663	5.55	7.05	4.95
Jammu & Kashmir	223	160	649	-	18.64	-
Karnataka	1167	1867	5268	3.06	15.61	7.98
Kerala	1367	1249	1330	13.87	-0.53	-1.19
Madhya Pradesh	349	414	1298	-0.12	15.49	9.76
Maharashtra	1387	1960	3771	2.49	3.30	3.74
Orissa	262	334	1166	9.35	16.10	5.41
Other States	203	252.5	322	1.93	1.97	2.13
Punjab	989	2229	3444	20.49	3.17	10.14
Rajasthan	501	638	1851	2.00	14.76	7.16
Tamil Nadu	2274	3235	5285	3.51	7.35	4.80
Uttar Pradesh	2638	1795	4044	-3.66	10.42	0.01
West Bengal	634	1006	2776	3.72	13.21	8.54
All India	15990	19766	44621	3.53	10.53	5.42

Source: BAHS (various issues)

The skewed development of AI related infrastructures (AI centers, semen production centers, Frozen semen banks, cattle breeding farms) led to the considerable regional disparities in the spread of AIs .The regional variations in the spread of AI is explicitly clear from the Table 4.4.2. At all India level, one AI center is required to serve 1901 adult female animals. The situation is worse in Assam, Bihar, Jammu & Kashmir, and Madhya Pradesh. Each AI center serves more than 3500 dairy animals in these states. Within the states, the distribution of AI centers is highly skewed. The spread of AI centers is not uniform across states.

4.4.3 Sources of Artificial Insemination: Changing role of service providers

Institutional framework for delivery of AI services has been dominated by animal husbandry departments (AHDs). In 1997 out of 48243 AI centers, 45666 centers, accounting for about 96% of the total AI centers, were controlled by Government departments. However in recent years a significant increase in the AI centers run by other organizations like cooperatives, NGOs and private sector has taken place. In 2010 there were about 18000 AI centers functioning under the

ambit of cooperatives or NGOs. The dominance of government departments in running the AI centers has been eroding overtime.

4.4.4 Adequacy and Quality of AI Services

In total all the agencies in the country carried out about 44.6 million artificial inseminations in 2009-10 (GoI, 2010). Considering an average number of 2.5 services per conception, the AI services cover only about 22 per cent of the dairy animal population (127 in adult females in milk and dry cows and buffalos). About 90% of the inseminations are reported to be done in cows and only about 10% in buffaloes (Bansil and Malhotra, 2006). This implies about 9 per cent of the milch (in-milk and dry) buffaloes (47.22 million) and 22% of the total milch cows are inseminated each year, indicating the low coverage of breeding services. The coverage of breeding services needs to be increased substantially to cater to the growing needs of breeding requirements.

Table 4.19: Adequacy of AI centers across states

States	No. of AI Centres	Number of milch animals to be served by one AI Centre	% of Female cattle covered by AIs
Andhra Pradesh	4842	2134	19.5
Assam	749	7156	1.5
Bihar	1401	8070	3.4
Gujarat	1586	5850	22.3
Haryana	2378	1665	20.6
Himachal Pradesh	1324	1407	14.2
Jammu & Kashmir	550	5236	9.0
Karnataka	3774	2424	23.0
Kerala	2445	652	33.4
Madhya Pradesh	2243	7455	2.0
Maharashtra	4566	2539	13.0
Orissa	2201	2828	7.5
Punjab	2350	1829	32.1
Rajasthan	2632	5436	5.2
Tamil Nadu	3177	2659	25.0
Uttar Pradesh	3079	4164	11.6
West Bengal	1262	10222	8.6
India	67048	1901	22.0

Source: BAHS (various issues)

Besides the low coverage, the quality of service provided is also poor. The quality of AI can be evaluated by different indicators such as ratio of adoption of crossbred and AIs performed, conception rate and the cost per calf born. The success of AIs in terms of conception rate and cost per calf born is still not encouraging. The conception rates (CR) in most of the states, by and large, range from 40-49% in field conditions. Although studies in some states show much lower rates. For instance, rates as low as 20% in Orissa and parts of Haryana (area served by ICDP Gurgaon) and 38% in Uttar Pradesh have been recorded, while in some areas of Andhra Pradesh and Gujarat the CR is over 50%. Even on the farm of the National Dairy Research Institute, the CR in cows (50%) is not much higher than that achieved in the field. Further, the success rate of AI in buffaloes is about 10% lower than in cows, even on organized farms. NGOs such as BAIF and the private sector suppliers have reportedly achieved a relatively higher conception rates of more than 50%. The conception rates reported by private service providers in some states were more than 70% (Sirohi *et al.*, 2008).

Studies on factors affecting CR in cattle indicate that by bringing more efficiency in four important factors, cow fertility, estrous detection accuracy, semen fertility and AI technique, the CR can be between improved upto 65-70% (Smith, undated). In Indian field conditions also, accurate detection of heat symptoms and stage of estrus in animals are reported to be very critical factors

affecting the CR in cattle (Bhagat and Gokhale, 1999) and buffaloes (Kumaresan and Ansari, 2001).

The poor coverage of AI and its low success are attributable to several factors. Although the country has perhaps the largest AI network in the world, considering the size of the country and its livestock population, the existing supporting infrastructural facilities like, semen production centres (68), bull semen stations (159), liquid nitrogen plants (130), frozen semen stations and banks (152) are far less in number to ensure adequate and timely availability of quality semen at the AI centres. Further, a large number of these facilities are either non-functional or providing poor quality services.

The problem of inadequate quantity and poor quality of semen doses and poorly trained inseminators has been widely reported as the serious constraints for success and spread of AIs (Singh et al., 2006; Singh and Chauhan, 2006). The high incidence of reproductive disorders in animals also poses technological constraints to the adoption and efficiency of AI services. Singh *et al*. (1998) found that the problems of repeat breeding, anoestrus condition, incidence of reproductive disorders were common among nearly one-fourth to one-third of the sample farmers adopting crossbreeding in Punjab, Karnataka and West Bengal.

4.4.5 Cost of AI Services

Another dimension of efficiency of AI services is its pricing. Pricing of AI services depends largely on the types of service providers. Officially, the government provides this service to the farmers at the AI centres free of cost or at a very nominal price, ranging from Rs. 5-20 per insemination. These official charges are grossly inadequate to cover the actual costs that range from Rs.150-250. The empirical evidence from various parts of the country (Ahuja, 1999; Ahuja et al., 2003; Bhowmik, 2006) indicates that although, in practice, the farmers pay much more than the stipulated fees, the additional money goes as direct payment to the inseminators for timely services and/or providing the service at the farmers' doorstep rather than towards the material cost of insemination. The cooperatives, NGOs and private AI practitioners also deliver services at the farmers' door step at somewhat higher prices than charged at government AI centres or by Government inseminators for home service. However, while the private sector does not subsidize the service there is an element of subsidy in the service provided by others sectors, viz. government, cooperative and voluntary organizations (Ahuja, 1999). The size of the subsidy varies across type of service provider, the lowest being for cooperatives.

From the farmers' perspective, the effective cost of delivery by the NGOs and private AI practitioners is lower than the government system due to better conception rates (Ahuja et al., 2000). It is likely that the carrying out of timely inseminations with better quality semen by the non-government vis-à-vis the government service providers is an important reason for better conception rates deliverable by the former. In particular the non-government sector may be able to deliver timely AI better than the government sector. The estimates made by Satish and Kumar (1993) also show that in Tamil Nadu the total cost per calf to the farmer from insemination by the government was 30% higher than those provided by BAIF. However, it needs to be emphasized that comparing cost effectiveness of NGOs and government in delivering services to the rural poor may sometimes be irrelevant and even misleading as they may have different objectives and seek to achieve them by different means. Nevertheless, successful examples of private AI service providers suggest that privatization of AI has the potential to make the services more responsive and demand driven and therefore likely to be more sustainable.

4.4.6 Recent Initiatives and Constraints in Breeding Strategies

Concerned over the poor status of breeding services in the country, the Government of India initiated the National Project for Cattle and Buffalo Breeding (NPCBB) in October 2000 to strengthen the coverage and efficacy of breeding services. Unfortunately, NPCBB also suffers from a plethora of problems such as lack of quality bulls for semen production, inability to provide uninterrupted supply of liquid nitrogen etc. Hence, after seven years of inception of this 10 year program, the progress is very slow in light of its targets (GoI, 2007), particularly in terms of converting fixed government AI centres into mobile ones. The reduction in travelling and waiting time for accessing AI services that can be facilitated through mobile centres has the potential to increase the utilization rate of these service (Ahuja et al., 2000).

Another weakness of the breeding policies and strategies in India is reflected in the negligence of buffaloes in breed development programs. Buffaloes have been playing an increasingly larger role in milk output, Buffalo breeding has so far received little attention there is anecdotal evidence that dairy farmers are themselves are selecting good buffaloes breeds. But like its indigenous cattle counter parts, formal sector breeding policy and research has given little support to such farmers to exploit the genetic potential of local breeds.

4.4.7 Veterinary Services

There has been substantial growth in veterinary services. Between 1972 and 2010, the number of veterinary institutions and veterinarians increased by six times (Table 4.20). But veterinary facilities in the country are still poor. One veterinary center caters to the need of more than six thousand animals. Further, the veterinary centers are not equipped with adequate number of trained veterinary professionals. There is roughly only one veterinarian for each veterinary Centre. Consequently, a large number of animals do not get veterinary care due to the inadequacy of animal health care services.

Table 4.20: Trends in veterinary services

Year	No. of Veterinary institutions	No. of veterinarians	Cattle equivalent units	
			Per institution	Per veterinarian
1972	9495	10,800	26,174	23,012
1982	33323	18,000	8394	15,540
1992	40586	33,600	7632	9219
1997	50846	37,200	6129	8377
2003	51973	38,100	5926	8084
2010	54906	57, 509	-	-

Source: BAHS (various issues)

4.4.8 Feed and Fodder Market in India

The adequate provision of feed and fodder is a *sine-qua-non* for harnessing the potential of dairy sector in India. India has remained a chronic deficit in feed. Milch animals have been traditionally underfed in the country and probably it is one of the reasons for lower milk productivity of these animals. The different estimates for the availability and requirement of feed and fodder pointed about the looming threat of feed scarcity in India. If issues of feed scarcities are not addressed properly the sustainability of growth of Indian dairy sector would be under question. The National Commission on Agriculture (1976) estimated deficit in dry fodder, green fodder and concentrates to the extent of 49, 53 and 43% respectively for the year 1972-73. Feed deficit, however, declined over time due to significant increase in production of food, feed crops. In 1991 the estimated deficit in dry fodder, green fodder and concentrates were reported to be 31 and 23 and 47% respectively (Singh and Majumdar, 1992). The estimates of demand and supply of different feed stuffs by Birthal et al. (2005) showed significant reduction in deficit in dry fodder, only 10%. Deficit in green fodder and concentrates, however, were reported to be 32% and 40%

respectively. The estimates of feed availability vary widely. As per the estimate of National Institute of Animal Nutrition and Physiology in 2005, out of 890 million tonnes of feed produced in India, 44% came from crop residues, 34% from planted fodder residues, 18% from forests, fallow land, common property resources and wastelands. Less than four percent was concentrates. Ramchandra *et al.* (2007) estimated that in 2004-05, 527 million tonnes of feed were available of which 69% was dry fodder, 24% was green fodder and 7% were concentrates (Table 4.21). Recently, Dikshit and Birthal (2010) on the basis of comprehensive field survey data estimated the total consumption of 757 million tonnes of green fodder, 466 million tonnes of dry fodder and 47 million tonnes of concentrates in 2003. The estimates of green fodder consumption was considerably higher than the other estimates. However, in spite of varying estimates the persistence of feed –deficit is a widely acknowledged fact in India. Feed availability varies access different agro ecological zones. Further the feed availability varies across agro-eco regions. Feed availability per adult cattle unit equivalent is the highest in irrigated zone, followed by rainfed, arid, hill and coastal zones. Rice and wheat straws account for half of the dry fodder supply and coarse cereals' stovers and sugarcane tops contribute 39%. The rest is contributed by leguminous crops. Interestingly in parts of the North West Indo Gangetic plain, rice straw is not considered as a valued feed and is regularly burnt while it is regularly fed to livestock in Bihar and West Bengal (Erestein *et al*., 2007). For instance, Punjab burns in situ some 81% of rice straw and 48% of wheat straw produced in the states annually.

Table 4.21: Availability of fodder across different agro eco systems

Ecosystem	Dry fodder	Green fodder	Concentrates	Total	Per Adult cattle unit (kg/day)
Arid	9.8	5.9	2	17.7	5.26
Coastal	21.8	4.9	1.6	28.3	3.93
Hill and mountain	23.6	10.3	1.5	35.4	4.99
Irrigated	155.4	41.9	11.3	208.6	8.33
Rainfed	155.2	63.5	17.9	236.6	5.77
Total	365.8	126.5	34.3	526.6	6.29

Source: Ramachandra et al. (2007)

Cultivated fodders account for about 65% of the green fodder and the rest 35% is contributed by common grazing lands. Some estimates suggest that cultivated fodder and gathered grassers account almost equally to the green fodder consumption. The area under fodder cultivation has stagnated at about 8.5 -9.0 million accounting for 4 to 5 percent of the total cultivated area. Fodder cultivation for livestock is a common practice only in selected states that are more advanced in milk production such as Punjab, Haryana, Western Uttar Pradesh and parts of Gujarat and Rajasthan. The land used for green fodder production is around 10% or more in these states. Sorghum and berseem occupy 50% of the land under fodder followed by lucerne, maize, bajra and oats. The situation of common grazing lands is also not encouraging. The common property resources (CPRs) accounted for 18% of geographical area in 1980-81, which declined to 15.5% in 2006-07. Area under permanent pastures and grazing lands comprises a mere 3.2% of the total area and has been declining steadily (Table 4.22).

The composition of feed consumption has changed overtime. Concentrates accounted for 2 percent of total feed in 1970-71. In 1995-96, its share in total feed went up to 7.63% (Kumar and Pandey, 1999). In 2003, concentrates accounted for 6.5% of dry matter, 9.9 % of TDN and 27% of the DCP consumption (Dikhshit and Brithal, 2010). Most of the concentrate cattle feeds used by the farmers are feed ingredients. The different estimates put the consumption of concentrates from 35 to 47 million tonnes. Out of total concentrates consumed, cereals comprised 48%, pulses 8.3%, oilcakes 37%, manufactured feed comprised only 6.2%.

Table 4.22: Grazing resources in India

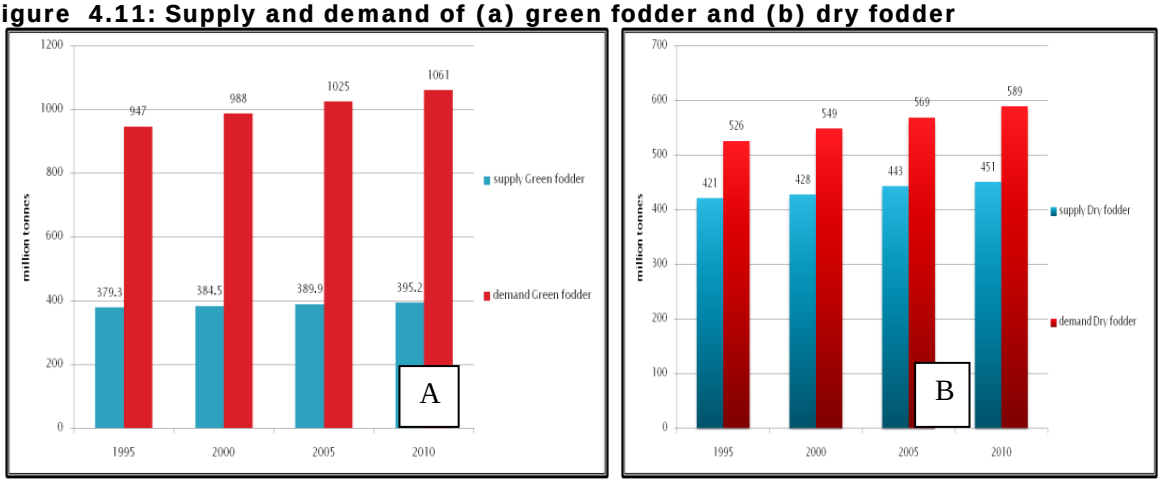
Year	1980-81	1990-91	2000-01	2006-07
Geographical area	328.7	328.7	328.7	328.7
Forests	67.5	67.8	69.5	69.8
Permanent pastures and grazing lands	12	11.4	10.7	10.4
Culturable waste land	16.7	15	13.6	13.2

Fallow and other than current fallows	9.7	9.7	9.9	10
Barren and unculturable wastelands	20	19.4	17.6	17.4
Total CPRs(excluding forests)	58.4	55.5	51.8	51
CPR as % of geographical area	17.8	16.9	15.7	15.5
Permanent pastures and grazing land as % of geographical area	3.6	3.5	3.2	3.2
% of gross cropped area under fodder crops	-	4.17	5.21	4.3
Livestock unit (million no)	-	244	330.2	249.8
Livestock units/ha of CPR	5	5.9	6.1	4.9

Source: Agriculture statistics, Livestock Census

In view of persistent feed scarcity (see Figure 4.11) in terms of quantity and quality the mechanism for appropriate seed supply and crop choice for feed production need careful consideration further the strategies for better management of common property resources need to be designed through innovative ways of reconciling legal and administrative procedures and traditional institutions. The effective and efficient management of CPR is particularly important in fragile ecology like arid and hilly regions where grazing is still practiced by substantial section of dairy farmers.

Figure 4.11: Supply and demand of (a) green fodder and (b) dry fodder



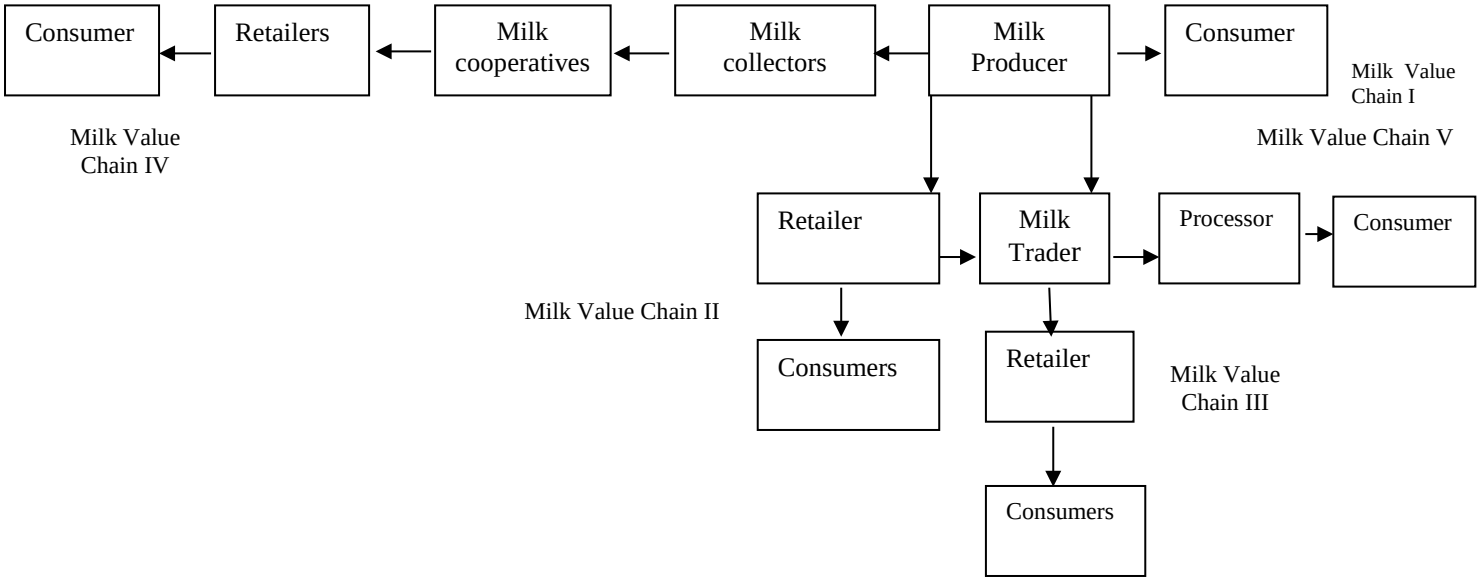
Source: State planning board Govt. of Kerala

4.5 STRUCTURAL CHANGES IN MILK MARKETING AND PROCESSING

4.5.1 Evolution of Milk Marketing System in India

Milk marketing historically has been an unorganized activity in India. The present structure of milk marketing in India is an outcome of the demographics, traditions, religions and infrastructure developments, constraints and limitations (see Figure 4.12 for a scheme distinguishing 5 value chains). A primary characteristic of milk marketing and distribution in India is the persistence of dominance of the informal sector in spite of several attempts to develop organized milk marketing in the past. The Government attempted several strategies to develop organized milk marketing in India since 1950. These efforts initially were made in the Metros followed by major cities in India. Due to lack of vertical integration in the milk supply system, most of these interventions used to depend on imported commodities for its sustenance. These efforts for developing organized milk marketing thus did not meet with requisite success. However, a vertically integrated cooperative structure with participatory involvement of farmers were gaining popularity in western part of India. This, movement, though commenced in 1946, received wide acknowledgement only in mid 1960s. The cooperative movement which originated in a small town called 'Anand' in the state of Gujarat became popular as 'Anand Pattern' of dairy development. Subsequently, 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 dairy development policy. This policy initiative helped to turn the Indian milk marketing around. The strategy for organized milk marketing got a further boost with the establishment of National Dairy Development Board (NDDB) in 1965 and launching of Operation Flood program in 1970. Another turn around in the milk marketing came in the early 1990s when the Government of India introduced major economic reforms that favoured increasing privatization and liberalization of the economy. The Indian dairy industry too was opened for private/foreign investments and thus facilitated the entry of organized private dairies in the Indian milk market. Thus, four types of milk marketing chains have evolved in India; out of which three are institutional, consisting of government, cooperative and private/multinationals termed as the organized dairy sector. The fourth type is known as the traditional or unorganized informal sector. The important marketing channels of milk flows are

Figure 4.12: Milk marketing chains in India



about one-third of the milk produced is retained on the farm for food and feed and the remaining two-third enters the market. The marketed surplus on farms varies among states and it is influenced by several factors including the herd size, family size, income of the households and food habits of the milk producers. For instance, the marketed milk was estimated to be 49% in Bihar, 67% in Punjab and 75% in Western Uttar Pradesh (Kumar et al., 2010). Out of the total marketed milk, 75% is handled by the informal or traditional milk marketing chains and the remaining 25 % is handled by the formal or modern milk marketing chains. The overwhelming dominance of informal sector can be attributed to several factors which include the consumers' preference for fresh milk, the perceived credibility of vendors to supply better quality milk, the consumers' unwillingness to pay additional cost for pasteurization and packaging, lack of alternative marketing channels in some areas, informal nature of business transactions, long-term relationship between vendors and milk producers etc. In fact, the much hyped cooperative dairy development in India has not yet been able to significantly affect the dominance of these informal milk market agents. Nevertheless, the formal milk marketing chains are spreading their wings very fast in the recent years. The expansion of modern milk marketing chains is expected to accelerate further because of increasing income, urbanization, changing consumers' preference for processed foods, growing awareness among the consumers about the food safety and quality issues. The structural changes observed in the dairy value chain is largely driven by change in demand patterns from traditional products to better value added and packaged products that are of improved quality and hygiene. This provides an opportunity for greater investments in technology and innovations in marketing practices wherein partnerships are important.

4.5.2 Role of Organized Sector in Milk Marketing

Operation Flood initiated in 1970s revolutionized liquid milk marketing in India, primarily led by the cooperative sector. The operation helped India not only become the largest producer of milk but also and most importantly link the smallest milk producer with the markets. While the bulk of milk production takes place in rural areas and the consumption centres are concentrated in the urban areas, the challenge lies in linking the two. Post Operation Flood, the existing urban markets helped absorb the increased flow of milk which brought respite to consumers in terms of improved availability. The cooperative network has expanded over time and a large number of private players have also entered the Indian dairy sector. Over time, dairy policies have facilitated a structural change, which to begin with provided a boost to development of cooperatives and at a later stage created opportunities for the private sector.

4.5.3 Co-operatives

Dairy cooperatives are the most important component of organized milk markets. The network of dairy cooperatives has expanded considerably since the launch of Operation Flood in 1970. The major indicators of performance of cooperatives are depicted in Table 4.23. An eleven fold increase in the number of dairy cooperative societies and an eight fold increase in their membership have been recorded during the past three decades. In 2010, cooperatives had about 14 million farmer members, including about 4 million women, spread over 140227 village cooperative societies (VCS) in about 350 districts.

Table 4.23: Performance of dairy co-operatives

	1980-81	1990-91	2003-04	2007-08	2010
Number of dairy cooperatives societies(DCS)	13,284	63,415	108574	1,33,349	140227
Farmer members (x103)	1747	7482	11,994	13,893	14071
Members/DCS	118	132	110	104	100
Annual milk procurement (x103t)	935	3541	6,381	9,157	9441
Milk procurement as % of milk production	3	6.6	7.2	5.7	8.4
Milk procurement /DCS (t/year)	70.4	55.8	59	69	67.3
Milk procurement per member (t/year)	0.54	0.47	0.53	0.66	0.67
Liquid milk marketed (% of procurement)	108.6	82.9	85.1	79.9	72.0

Source: BAHS, NDDB Reports

During this period, the annual milk procurement by cooperatives increased by more than ten times, from 935 thousand tonnes to 9441 thousand tones. The milk procurement by cooperatives accounted for about 3% of total production in 1980-81.In 2010, the milk procurement by cooperatives accounted for 8.4% of the milk production, and about 15 % of the milk marketed surplus.

The cooperatives handle about 50% of the total milk marketed and processed by formal or modern milk marketing chains. However, despite a horizontal expansion and an impressive performance of dairy cooperatives societies (DCS), no significant changes have occurred in the average size and scale of a village level dairy cooperative. Between 1980 and 2010, the number of members /DCS varied between 100 and 132 and milk procurement between 56 and 70 tonnes/DCS/year. Similarly, the milk procurement/member reached 670 kg/year. Lopsided growth of cooperatives is another concern.

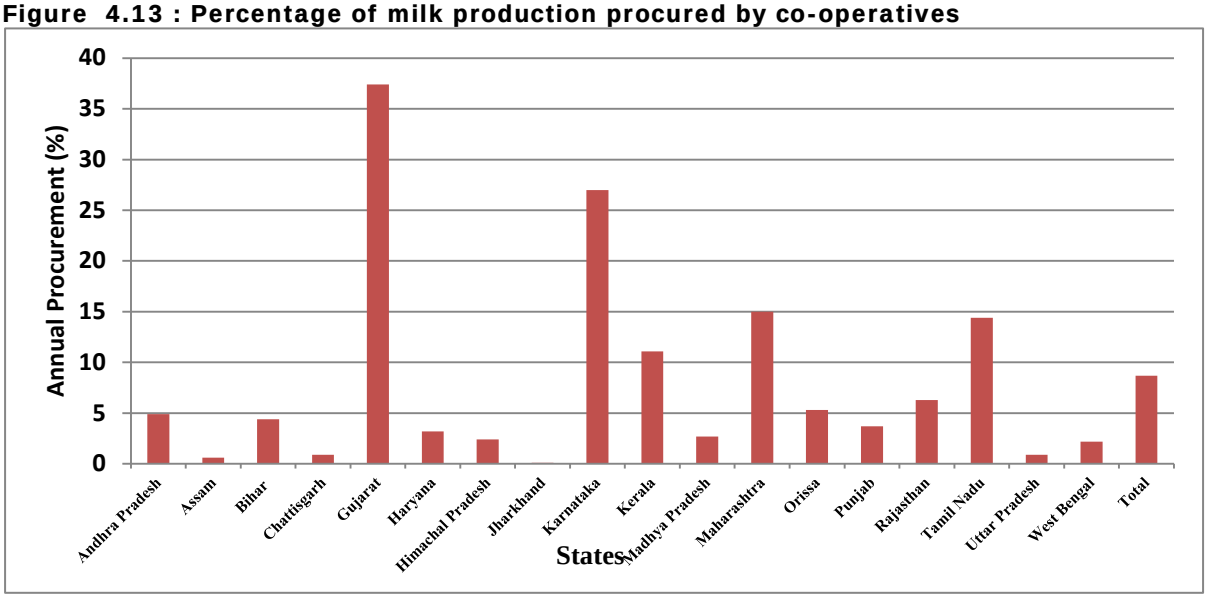
Table 4.24: Share of different states in milk procurement vis-a-vis and milk production by co-operatives

State	1998		2010	
	Milk Production (%)	Milk Procurement (%)	Milk Production (%)	Milk Procurement (%)
Andhra Pradesh	6.2	5.8	9.3	5.6
Assam	1.0	0.0	0.7	0.0
Bihar	4.7	1.6	6.7	2.9
Gujarat	6.8	30.9	7.9	35.0
Haryana	6.1	1.5	5.3	2.0
Himachal Pradesh	1.0	0.1	0.7	0.2
Jammu & Kashmir	1.6		1.4	
Karnataka	5.5	11.4	4.3	13.8
Kerala	3.2	2.5	2.3	3.0
Madhya Pradesh	7.5	1.5	7.2	2.1
Maharashtra	7.2	17.1	6.8	12.2
Orissa	0.9	0.6	1.5	0.9
Punjab	9.9	5.7	8.3	3.7
Rajasthan	9.0	5.1	8.5	6.4
Tamil Nadu	5.6	9.0	5.1	8.8
Uttar Pradesh	17.9	5.2	19.2	2.0
West Bengal	4.7	1.2	3.8	1.0

Source: BAHS (various issues)

The performance of dairy cooperative depicts striking variations across states. The milk procurement by cooperatives is concentrated in a few states only. About 70% of the milk procured comes from four states Gujarat (35%), Maharashtra (13%), Karnataka (13%), and Tamil Nadu (9%), while the share of these states in total milk production in the country is about 24 percent (Table 4.24). Further, in these states the milk procurement by cooperatives as a percentage of milk produced is impressive. In Gujarat, more than one third of the state's milk output is procured by cooperatives, followed by 27% in Karnataka, 15% in Maharashtra, 14% in Tamil Nadu, 11% in Kerala and 6% in Rajasthan (Figure 4.13). Milk producers in these states definitely have better access to cooperative milk market outlooks. In other states, cooperatives could procure less than 5% of the milk production. This biased pattern shows that cooperatives; investments and benefits have been concentrated in a few states especially in the western and southern regions of the country. In some states like Uttar Pradesh, Punjab and Haryana which makes quite considerable contribution to the total national milk production private sector has a sizeable presence in the milk market.

Figure 4.13 : Percentage of milk production procured by co-operatives



Source: BAHS, (various years)

The liquid milk sales dominate the marketing by cooperatives. Till about a decade ago, liquid milk marketing was largely in the domain of cooperative and government dairies. The private dairies were mostly involved in the manufacturing of milk products like milk powder, ghee, butter, dairy whitener, infant foods and some traditional milk products. However, in the changing dairy market scenario, several established private brands are now selling liquid milk. The trend is pervasive across different states with a few exceptions. This implies that the focus of milk marketing by cooperatives is to cater to the need of urban demand for liquid milk consumption and less attention is paid to the value added milk products. However, the gap between the milk procured and liquid milk marketed has been growing significantly. The liquid milk marketed dropped from 91% of procured milk in 1996 to 72% in 2010 (Table 4.25). The entry of established private dairies in the liquid milk marketing and the expansion of manufacturing and marketing of some cooperative dairies to include value added milk products like ice cream, cheese, and traditional milk products are the possible reasons for the declining trend in the sale of procured milk by cooperatives in liquid form. If the recent trend continuous, the dairy cooperatives would be selling lesser and lesser proportion of their procured milk in liquid form. Such trends would expose the cooperatives and consequently their members to both opportunities as well as challenges. The opportunities lie in reaping the benefits from the ever growing markets value added milk and milk products. The challenges involve creating adequate professional expertise and marketing infrastructure for manufacturing of value added consumer milk products.

Table 4.25: Extent of liquid milk sale by co-operatives across different states

(Percent)

Liquid milk sale as percentage of milk procured by cooperatives			
State	1996	2004	2010
Andhra Pradesh	106.0	94.2	98.0
Assam	160.0	266.7	240.0
Bihar	112.9	111.2	91.0
Gujarat	45.3	41.7	35.4
Haryana	52.1	46.6	73.7
Himachal Pradesh	125.0	64.0	32.7
Karnataka	94.2	67.6	69.2
Kerala	100.3	120.5	138.8
Madhya Pradesh	138.0	103.2	87.8
Maharashtra	96.2	98.7	59.7
Orissa	158.9	103.9	109.5

Punjab	50.2	66.6	75.9
Rajasthan	55.2	82.6	82.5
Tamil Nadu	94.7	72.5	42.9
Uttar Pradesh	59.2	54.7	77.6
West Bengal	488.6	251.7	14.5
India	90.9	85.5	72.0

Source: BAHS (Various issues)
Note: More than 100% liquid milk sale is due to the import of these cooperatives from other states

4.5.4 Changes in Formal Milk Processing Structure

The dairy processing sector is particularly important as it highlights the importance and need of close inter-linkages which actually process and conserve the milk which has a short shelf life. Dairy processing activities include both liquid milk processing and the manufacture of all milk products but excludes non registered processing such as milk processing in homes and in small confectionery retailers such as halwais. The processing sector has witnessed significant changes overtime. Initially formal milk processing industries were dominated by cooperatives and government sector. But during 1990s, the private sector milk processing industries got a boost due to several policy reforms. These reforms include amendment in milk and milk products order and de-licensing of dairy industries. Consequent to opening up of the Indian dairy sector, there was a quantum jump in the number of milk processing plants. At present, there are 841 dairy processing units registered in India which process around 15% of the milk produced in the country. Out of the total number of dairy processing units registered under MMPO, 562 are private processing units and 243 are cooperative milk processing units and the remaining 36 are controlled by the government. Milk processing capacity has grown at an annual growth rate of four per cent over the last 15 years (Table 4.26). Most of the new capacity is being set up by the private sector. Milk processing capacity in the private sector increased annually by six percent between 1996 and 2010. Milk processing capacity of the cooperative sector has recorded an annual growth of three per cent during this period. Milk processing capacity of the government sector has been declining over time. In 1996 private sector accounted for about 44% of total milk processing capacity in India. Its share increased to 58% in 2010. The existing milk processing facilities have the capacity to process about 40% of milk production and about two-third of rural milk marketable surplus.

Table 4.26: Progress in milk processing capacities in India

Capacity of milk processing units (thousand litres/day)				
Year	Cooperatives	Private	Others	Total
1996	24207	24432	7270	55909
2002	28394	32415	12170	72979
2004	32898	36774	11706	81378
2006	36569.5	46085.3	15396	98051
2007	37335.5	49446	10221	97003
2010	37239.5	57063	4013	98315.5
	Share (%)			
1996	43.30	43.70	13.0	
2002	38.91	44.42	16.7	
2004	40.43	45.19	14.4	
2006	37.30	47.00	15.7	
2007	38.49	50.97	10.5	
2010	37.88	58.04	4.1	
	Compound annual growth rate (%)			
1996-2002	2.69	2.91	-17.05	0.27
2002-10	3.45	7.33	-16.88	5.09
1996-2010	3.12	6.25	-4.16	4.11

Source: BAHS (Various years)

The overwhelming increase in the private milk processing capacity is attributed to impetus witnessed in investment by private and multinational companies in recent years. However, the development of milk processing facilities appears to be regionally imbalanced and concentrated in a few states. Andhra Pradesh, Gujarat, Maharashtra and Uttar Pradesh together account for about 63% of the total milk processing capacity of the country (Table 4.27). Regional imbalance is vividly clear in the processing units under all cooperatives, government and the private sector. Five states Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu and Uttar Pradesh account for about 70% of the cooperatives milk processing capacity. Like cooperatives, concentration of private sector processing facilities is also confined to a few states. 80% of the private milk processing capacity is concentrated in Andhra Pradesh, Madhya Pradesh, Maharashtra, Punjab, Tamil Nadu and Uttar Pradesh.

Table 4.27: Share of different states in national milk processing capacities, 2010

States	Cooperative		Private		Others		Total	
	No.	Capacity	No.	Capacity	No.	Capacity	No.	Capacity
Andhra Pradesh	3.3	5.2	4.6	8.6	0.0	0.0	4.0	7.0
Bihar	3.7	1.6	0.4	0.4	0.0	0.0	1.3	0.8
Chhattisgarh	0.4	0.3	0.0	0.0	0.0	0.0	0.1	0.1
Gujarat	6.6	26.4	2.1	1.4	8.3	10.5	3.7	11.2
Haryana	2.1	1.3	4.5	3.4	2.8	1.5	3.7	2.5
Himachal Pradesh	1.2	0.1	0.7	1.0	0.0	0.0	0.8	0.6
Jammu & Kashmir	0.0	0.0	0.2	0.1	0.0	0.0	0.1	0.0
Karnataka	6.2	9.1	1.8	1.5	0.0	0.0	3.0	4.3
Kerala	5.8	3.1	1.8	0.7	0.0	0.0	2.9	1.6
Madhya Pradesh	2.1	2.7	6.1	6.8	0.0	0.0	4.6	5.0
Maharashtra	30.5	19.5	34.2	21.0	86.1	75.6	35.3	22.7
Orissa	2.5	0.5	0.2	0.0	0.0	0.0	0.8	0.2
Punjab	4.9	4.6	8.2	6.9	0.0	0.0	6.9	5.8
Rajasthan	7.0	5.4	3.4	3.2	0.0	0.0	4.3	3.9
Tamil Nadu	6.6	11.1	3.0	6.9	0.0	0.0	3.9	8.2
Uttar Pradesh	14.4	6.7	26.2	30.4	0.0	0.0	21.6	20.1
West Bengal	1.2	2.2	2.5	2.2	0.0	0.0	2.0	2.1
India	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: BAHS, 2010

The trends in its share in total milk capacity different of states, suggests that once the private sector was allowed to enter the industry, most of the plants of the private sector were established in the already leading dairy states to take advantage of larger milk supply and pre-existing infrastructure created to support development of cooperatives (Table 4.28). This fosters a fierce competition between private sector and cooperatives in few states and farmers have alternative options for maximizing their welfare. The great emphasis on food safety and quality of milk products puts further pressure on the expansion of traditional milk processing and thus the role of modern or formal processing sector would increase further in the future. Within formal sector, the role of private sector appears to further increase in future due to several conducive measures taken to facilitate private players in the dairy processing sector.

Table 4.28: Share of cooperatives, government and private sector in milk processing capacities of different states, 2010

States	Share of different sectors (%)					
	Cooperative		Private		Others	
	No.	Cap	No.	Cap	No.	Cap
Andhra Pradesh	23.5	28.4	76.5	71.6	0.0	0.0
Bihar	25.9	29.5	74.1	70.5	0.0	0.0

Chhattisgarh	100.0	100.0	0.0	0.0	0.0	0.0
Gujarat	51.6	89.2	38.7	7.0	9.7	3.8
Haryana	16.1	21.3	80.6	78.3	3.2	2.5
Himachal Pradesh	42.9	79.8	57.1	92.5	0.0	0.0
Jammu & Kashmir	0.0	0.0	100.0	100.0	0.0	0.0
Karnataka	60.0	80.3	40.0	19.7	0.0	0.0
Kerala	58.3	75.7	41.7	24.3	0.0	0.0
Madhya Pradesh	12.8	20.7	87.2	79.3	0.0	0.0
Maharashtra	24.9	32.6	64.6	53.8	10.4	13.6
Orissa	85.7	87.5	14.3	12.5	0.0	0.0
Punjab	20.7	30.4	79.3	69.6	0.0	0.0
Rajasthan	47.2	52.3	52.8	47.7	0.0	0.0
Tamil Nadu	48.5	51.4	51.5	48.6	0.0	0.0
Uttar Pradesh	19.2	12.5	80.8	87.5	0.0	0.0
West Bengal	17.6	39.2	82.4	60.8	0.0	0.0

Source: BAHS, 2010

4.5.5 Strengths and Weaknesses of Different Milk Marketing Chains

The analysis of emerging milk marketing system in India clearly shows that in the foreseeable future all types of milk marketing chains (formal and informal) would exist. The co-existence of a member of milk marketing channels in fact would be beneficial for the farmers and the competition would improve the efficiency of the milk markets. Further, a particular value chain may not suit to all regions and therefore, the understanding of strengths and weaknesses of different marketing chains is essential.

A SWOT analysis of different milk market chains would be helpful in developing futuristic strategic milk market policies. The strengths, weaknesses, threats, and opportunities of different players of milk market are depicted in Table 4.29. The SWOT analysis clearly points out the necessity for co-existence of different types of milk marketing chains to foster enough competition in the Indian milk market. The traditional milk markets need to be addressed in a constructive manner in view of its continued dominance in the milk marketing and processing. However, the increased attention to quality and safety by the growing middle class work against these markets and facilitate the expansion of modern integrated milk markets. However, in the short run the quality gap of the informal markets can be addressed to a large extent by popularizing training and certification programes for small scale milk traders and processors.

Table 4.29: Strength, weakness, opportunity and threat of different types of milk marketing chains

	Strengths	Weaknesses	Opportunities	Threats
Co-operatives	• Assured market • Provision of inputs, AI, feed, and extension services • Safety of the farmers' returns • Quality control of milk • Sense of ownership among the farmers • Farmers' share in co-operatives assets and investment • Easy access of producers to collection centres • Bonus payment • Strong network	• Relatively lower prices • Delays in payment • Possibility to bear the cost of mis-management of the co-operative functionaries • Lack of decentralization in decision making • Statistic price fixation	• Improved inputs and technical know-how • Marketing, packaging, grading storage, processing by cooperatives • Potential for scaling up • Greater bargaining power • Lower risk • Potential for access to high value markets	• Dependence on subsidies and internal management assistance • Loss due to inefficient management • Supply of low quality inputs • Deferred payment • Lack of flexibility for adaptation to the changing economic and business environments
Informal sector	• Payment of higher prices particularly in absence of competition • Payment of cash without any delay • Frequent negotiations of prices • Easy advances to farmers • Collection of milk from farmer's doorstep • Provision of supplementary services • Strong inter-personal relationships	• Possibility of loss of farmers' money • Unreliable market • Lack of provision of inputs and extension services • Arbitrary changes of prices without prior knowledge. • Lack of transparency in the dealings	• Long-term sustainability • No need of formalization • Many supplementary services	• Irregularity in payment • Limited access to high value markets • No hedging against unforeseen risk • Conflict with social obligation • High risk in absence of third party
Private Dairies	• Assured payments at agreed time • Correct measurement of volume and quality • Bears cost of spoilage after receiving milk • Relatively higher prices in the presence of competition from the alternative buyers	• It is not always reliable • Arbitrary changes in the amounts they buy and the prices fixed without prior warning to farmer • May place limits on the amounts farmers can supply thereby excluding certain sections of milk producers	• Higher returns • Access to improved inputs, technical assistance, transport and packaging • Improvement in quality • Secure market • Additional market opportunities • Better post production handling	• Increase in risk • Exclusion due to economics of scale • Sustainability in question • Possibility of exclusion on account of variety, quality and safety specifications • Delayed payments • Restriction in access to open market

4.5.6 A Brief Overview of Some Modern Milk Marketing Chains

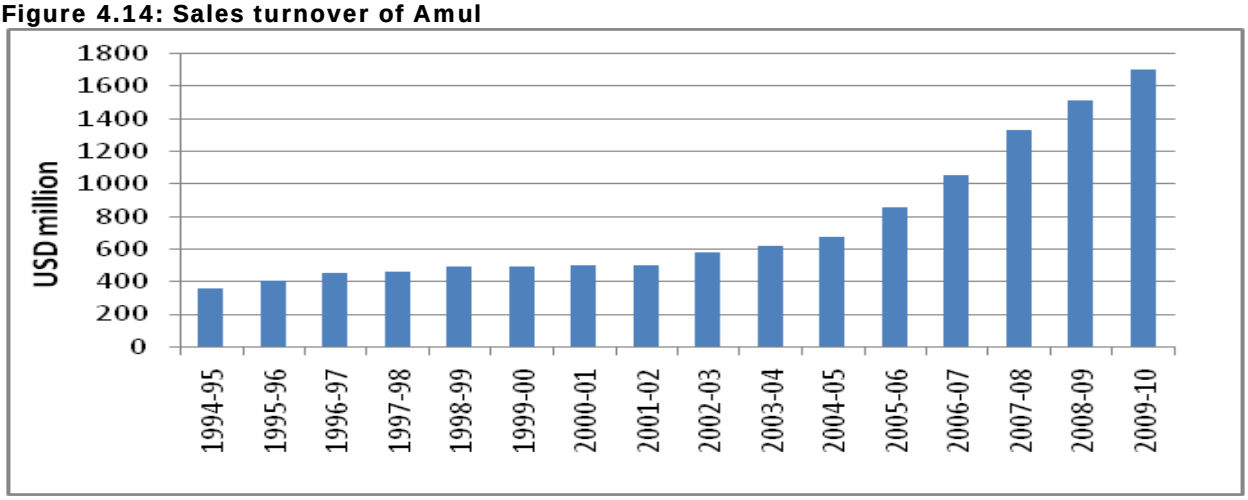
The success of Anand Co-operative models of milk marketing played and important role to bring unprecedented success to the Indian dairy sector. Similarly after the economic reforms the vibrant private players have also emerged in the Indian milk market. Understanding these established and emerging players will help to understand the emerging patterns of milk market in the future. The next section gives brief overview of these important milk marketing players.

4.5.7 **Amul**

The Amul model of dairy marketing inspired the white revolution in India. Established in 1946 in Anand in Kaira district of Gujarat, farmers came together to collect and process milk produced by them. The initiative was a response to the existing unfair marketing practices and the cooperative model helped envisage decentralized milk collection at the village level and then supplying to the major milk markets across the country. The brand name Amul came into existence later in 1955. The dairy plant in Anand, among other things has the distinction of being the first modern dairy plant to produce skimmed milk powder from buffalo milk on a commercial scale in the world. It had the capacity to pasteurise 300,000 pounds of milk per day, manufacture 10,000 pounds of butter per day, 12,500 pounds of milk powder per day and 1,200 pounds of casein per day (Chandra et.al. 2003). The success of the Kaira District Milk Producers' Union Limited resulted in farmers coming together in other districts. In order to avoid cooperatives from within the state competing against one another and also save on costs of operation, all state cooperatives were brought under one apex marketing institution. In 1973, the Gujarat Co-operative Milk Marketing Federation (GCMMF) was established and the brand name Amul was given over to it. The success of Amul as a dairy cooperative in India has been quite unique in terms of its brand image, market share and the state of art operations.

GCMMF is Indi's largest food marketing organization with a sales turnover of USD 1.7 billion in 2009-10 from USD 850 million in 2005-06 (see Figure 4.14). Comprising of 13 district cooperative milk producers' union, it covers 15.322 village societies and 2.9 million farmer members. With a total milk handling capacity of 13.07 million litres per day, GCMMF collected 3.3 billion litres of milk in 2009-10 (about 3 percent of the milk produced in India). Liquid milk contributes 40 percent to its revenues.

Figure 4.14: Sales turnover of Amul



Source: Amul website

The company's flagship products include milk, butter, infant milk powder, and dairy whitener, cheese is a more recent addition to the product basket. Over time, Amul has widely diversified its product portfolio and entered the processed milk market in a major way. In 1997, Amul entered the ice cream segment (one of the few milk based ice cream) following Hindustan Lever's acquisition of Kwality, Milkfood and Dollops. In 1999, it hit the market with branded yoghurt "Masti Dahi". Amul ventured into tetra packaged milk segment way back in 1983 and then again re-entered in 2000 with the launch of 'Amul Taaza" (non-sweetened, plain, low fat milk). Amul is also present in the cheese market with mozzarella and gouda cheese following the growing demand for cheese in India.[12] Amul accounts for

[12] Source: http://www.icmrindia.org/free%20resources/casestudies/amul2.htm

88 percent market share in butter, 63 percent share in infant milk, 45 percent in dairy whitener and about 26 percent share in packaged milk market valued at Rs 250 billion. Increased availability of liquid milk provided the scope for diversifying the basket. As of early 2000, GCMMF had 42 regional distribution centers in India, operated through more than 500,000 retail outlets and exported to more than 15 countries. Other than retailing milk and milk products through traditional networks, GCMMF has its own branded network "Amul Preferred Outlets" and plans to expand from 5,000 outlets in 2010 to about 10,000 by 2012. In 2010, APOs accounted for 3.7 percent of the total sales turnover of GCMMF and the target is to reach at least 10 percent in the near future. Media reports that Amul has ventured into a massive venture of marketing its processed chilled products like butter, cheese, paneer and ice cream to smaller districts and town (with a population of up to 5000). It is likely to adopt a hub and spoke model wherein it will develop feeder markets to supply these markets. It will appoint business partners or super distributors (nearly 200) in 2011 to service more than 3000 towns and semi urban cities (Bhushan, 2011).[13] Success of Amul as a dairy cooperative is driven by its sustainable linkages with the member farmers providing them the market as also backend services and being able to remain relatively low cost compared to its close competitors taking advantage of the economies of scale. Future plans of GCMMF is to increase its turnover more than three-fold to Rs 300 billion by 2020 from the current base of Rs 80 billion in It also plans 2009-10. [14] To procure 20 million litres of milk per day up from the current 9.2 million litres per day.

4.5.8 Mother Dairy

Delhi was set up in 1974 under the Operation Flood Program. It is now a wholly owned company of the National Dairy Development Board (NDDB) with a turnover of Rs 42 billion. Mother Dairy markets & sells dairy products under the Mother Dairy brand (like Liquid Milk, Dahi, Ice creams, Cheese and Butter), Dhara range of edible oils and the Safal range of fresh fruits & vegetables, frozen vegetables and fruit juices at a national level through its sales and distribution networks for marketing food items. Mother Dairy sources significant part of its requirement of liquid milk from dairy cooperatives. However freshness and other quality considerations have been a problem for Mother Dairy and the company is gearing up to address these issues. Recombined milk which constituted more than 40 percent of the total production is likely to be reduced heavily. Unlike dairy cooperatives, Mother Dairy does not have a strong procurement line of its own and hence finds it difficult to ensure consistent quality of milk. about 65 percent of the company revenue comes from liquid milk marketing which operates at low cost. This is typical of being a government body that does not have the freedom to tune tariffs and prices according to market signals. Nearly 85 percent of the revenue earned by Mother Dairy is paid back to dairy farmers as procurement price.

Mother Dairy markets approximately 2.8 million liters of milk daily in the markets of Delhi, Mumbai, Saurashtra and Hyderabad. Mother Dairy Milk has a market share of 66% in the branded sector in Delhi where it sells 2.3 million liters of milk daily and undertakes its marketing operations through around 14,000 retail outlets and 845 exclusive outlets of Mother Dairy. The company's derives significant competitive advantage from its unique distribution network of bulk vending booths, retail outlets and mobile units. Mother Dairy ice creams launched in the year 1995 have shown continuous growth over the years and today boasts of approximately 62% market share in Delhi and NCR. Mother Dairy also manufactures and markets a wide range of dairy products that include Butter, Dahi, Ghee, Cheese, UHT Milk, Lassi & Flavored Milk and most of these products are available across the country.

GCMMF that markets Amul beat Mother Dairy in the branded packaged milk in 2009, its frontline product and in its home turf, Delhi where it has been thriving for the last 35 years. Surprisingly, Amul entered the Delhi market in 2005 only and despite being more expensive (Amul Gold (full cream) cost Rs 36 per litre compared to Mother Dairy's at Rs 33, recently raised to Rs 35). Better taste and quality of the product helped take over the lead. With a new management in place, the company aims to double its revenue to Rs 100 billion by 2014-15. The national capital region (NCR) accounts for 75 percent of its current revenues and there are plans to expand its operations, focusing on south and west and generate about 35 percent of its revenues outside the NCR. The company is also planning to diversify and expand its product basket of value added processed products, markets for which are growing rapidly in India. The six point revival plan will focus on looking beyond Delhi, increasing their presence through traditional outlets, diversify toward health foods, hiring fresh talent and building a

[13] Amul kicks off largest distribution. Ratna Bhushan ET Bureau March 16, 2011. The Economic Times. http://articles.economictimes.indiatimes.com/2011-03-16/news/28697934_1_amul-paneer-small-towns

[14] http://www.fnbnews.com/article/detarchive.asp?articleid=29105&sectionid=40

younger team, turning hi-tech to be able to forecast market demand and mange stocks accordingly, and involve experts to help reduce operational costs and boost energy efficiency. [15]

4.5.9 Evolution of Private Players (domestic and multinationals)

The amendment of the Milk and Milk Products Order (MMPO) in March 2002 marked the entry of a large number of private companies into the dairy market. Dairy companies like Hatsun Agro Product Limited in Tamil Nadu, Heritage in Andhra Pradesh, Keventer in West Bengal and Dynamix in Maharashtra have a large presence in the Indian dairy market. More recently, big players such as Reliance, Bharti, Coca-Cola, PepsiCo, and Haryali Kisaan Bazaar among others have announced impressive investment plans in the dairy sector and some have already started linking up with farmers for procuring milk. The diversified Jaypee Group, under its group company Jaiprakash Agri Initiatives, is all set to make forays in the dairy sector.[16] The group plans to set up a one million litre per day milk processing plant in Uttar Pradesh with an investment of Rs 10 million. To meet the growing demand for milk, the government is working on a series of proposals to further liberalize the dairy sector and encourage entrepreneurs from the private sector. The department of animal husbandry, dairy and fisheries is expected to grant priority sector lending status to the dairy sector, even for loan amount of more than Rs 10 million. Initiatives like milk processing centers, chilling centers, bulk supply coolers and fodder plants could all be covered.[17]

Hatsun Agro Limited: It is one of the largest private player in the Indian dairy sector, sales of which have grown from around USD 4 million in 1997 to USD 183 million in 2008. The company procures around 1.8 million litre of liquid milk per day by directly collecting it from farmers spread over 4,500 villages in south India (Hatsun 2011). Its milk shed area is spread over 10 districts in Tamil Nadu and 3 in Karnataka and covers over 70,000 milk producers and 2000 medium and bulk milk vendors. The company has a milk collection system with chilling centers in more than 50 locations and a fleet of more than 1348 vehicles each covering a distance of 200 to 250 km every day on contract for procurement. The distribution network comprises of 150 wholesale distributors and more than 10,000 dealers for Arokya and around 850 direct selling agents for Hatsun Komatha milk. Together with providing 100 percent buyback, Hatsun provides a host of other services and inputs to help farmers improve the productivity of the milch animals and also maximize provides by reducing cost of production. For providing artificial insemination and adequate health care of animals, it has a fleet of 100 veterinary doctors and 174 inseminators. It has also tie ups with various banks to facilitate loans for buying animals at interest rate of 10.5 percent to 12.5 percent and also arranges insurance facilities.[18]

Heritage Group: Among other players in south India, the Heritage Group, (founded in 1992) is one of the fastest growing private sector enterprises in India. Dairy is one among the four business divisions under its flagship Company Heritage Foods (India) Limited (HFIL). The annual turnover of Heritage Foods crossed around USD 47 million (Rs 9 billion) in 2009-10 and is aiming for approximately USD 240 million (Rs 11 billion) in 2010-11..[19] Heritage's milk products have market presence both through own retail stores and other retail networks in Andhra Pradesh, Karnataka, Kerala, Tamil Nadu, Maharashtra and Orissa. Integrated agri operations are in Chittoor and Medak districts which form the backbone of the retail operations in Andhra Pradesh.

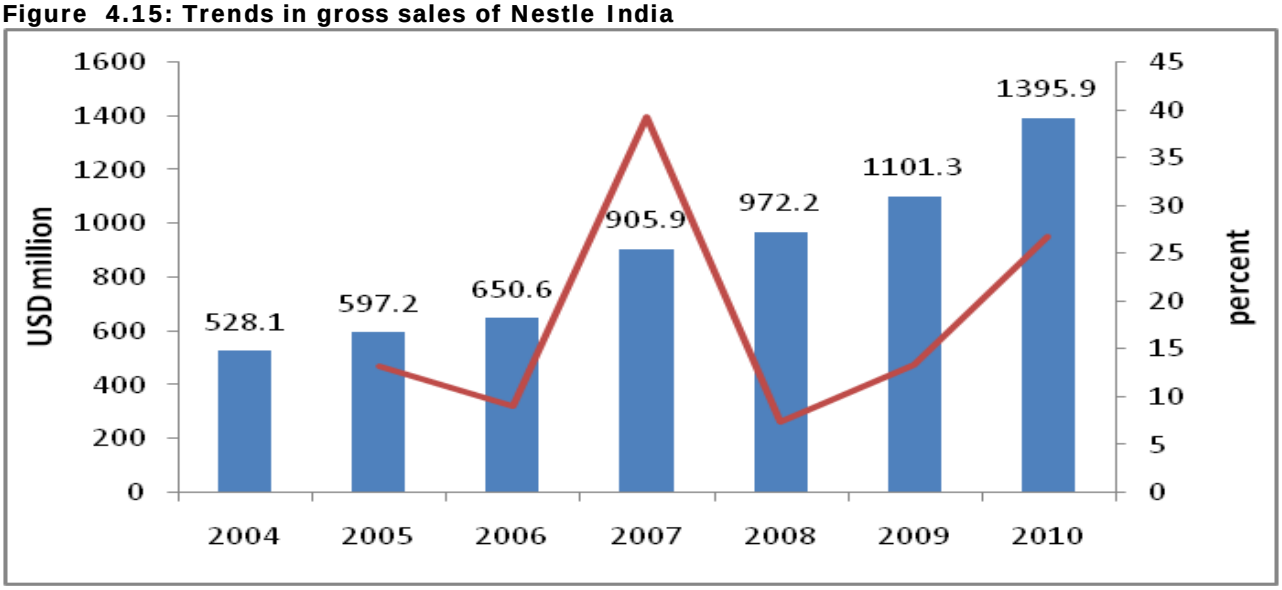
Reliance Dairy Foods Limited: Reliance Dairy Foods Limited a subsidiary of Reliance Retail is currently procuring liquid milk and marketing under the brand name "Dairy Pure" and has major expansion plans in procurement, and marketing liquid milk. It has plans to enter the branded milk market with "Life" posing stiff competition to established brands such as Amul, Nestle, Mother Dairy and the like by offering higher margins to retailers and 10 percent more milk to consumers. The new brand will be available in Haryana, Punjab, Rajasthan, National Capital Region, Himachal Pradesh, Tamil Nadu, and Andhra Pradesh.[20] The turnover of Reliance Dairy Foods Limited increased from

[15] http://articles.economictimes.indiatimes.com/2011-05-15/news/29545772_1_new-strategy-base-home-turf
[16] http://www.fnbnews.com/article/detarchive.asp?articleid=29395&sectionid=40
[17] http://www.fnbnews.com/article/detarchive.asp?articleid=29395&sectionid=40
[18] http://www.fnbnews.com/article/detarchive.asp?articleid=29395&sectionid=40
[19] http://www.hatsun.com/shows/history
[20] http://www.imagesfood.com/news.aspx?id=1524&topic=1

about Rs 658 million in 2007-08 to Rs 1.8 billion in 2008-09. Total assets stood at Rs 822 million in 2008-09 up from about Rs 390 million in 2007-08.[21] Nevertheless, its market presence is still small and needs to expand aggressively to match up with other leading players in the dairy sector who are already dominating the estimated Rs 400 billion branded milk distribution business, growing at the rate of 10 to 12 percent per annum.[22].

Nestle: Amongst multinationals, Nestle started operations in 1961 in Moga district of Punjab with 180 farmers, increased to 98,000 in 2006 and now about a 100,000 to source its daily requirement of liquid milk (Nestle 2006 & 2009). The second plant was set up at Choladi (Tamil Nadu), in 1967, then in Nanjangud (Karnataka), in 1989, and Samalkha (Haryana), in 1993. It further commissioned two factories - at Ponda and Bicholim, Goa, in 1995 and 1997 respectively. The seventh factory was set up at Pantnagar, Uttarakhand, in 2006. Nestle India clocked gross sales of USD 1.4 billion in 2010, up from USD 1.1 billion in 2009 (Figure 4.15). Milk products and nutrition account for nearly 45 percent of the net sales (in 2010). Export sales accounted for 5.5 percent of the gross sales in 2010.

Figure 4.15: Trends in gross sales of Nestle India



Source: Nestle, 2011

Other than procuring milk from farmers, Nestle has been providing backend services, which has been critical in growing and sustaining the firm farm linkages over time.

French foods giant Groupe Danone (worth USD 20 billion global revenues in 2010; fresh dairy products account for roughly 60 percent of the group's sales) had initially tied up with Wadia group (as part of Britania) in India and after the split, the subsidiary Danone India has ventured on its own and also scouting for an Indian partner to enter into joint venture or buyouts to be able to expand its market presence in the Indian dairy sector. The company has launched three products — chocolate smoothies (Choco Plus) in Hyderabad, plain yogurts (Danone Dahi) and a range of flavored yogurts (strawberry, mango and vanilla), in Pune and Maharashtra. It has partnered with Dynamix, as the co-manufacturer for Danone products in India.[23].Currently it is focusing on strengthening the backend cold chains which is critical for dairying. Danone products have found their way into more than 100 modern retail outlets and also at 1,200 neighborhood shops, and the growth is reported to be around 50 per cent. The company is focusing more on the modern trade and has gained presence at around 230 retail chains[24].The company is likely to launch a Base of the Pyramid project for India in the third quarter of 2011 which will focus on marketing products at affordable prices to the people at the bottom of the pyramid. The increasing presence of domestic and multinationals in the dairy sector is in line with the growing demand for healthy and nutrition food and it will be critical for these companies to bring about product innovation on these lines.

[21] http://www.indiaretailing.com/news.aspx?topic=1&Id=4310
[22] http://indianfoodbrands.blogspot.com/2010/02/reliance-dairy-to-market-milk-on-larger.html
[23] http://indianfoodbrands.blogspot.com/2010/02/reliance-dairy-to-market-milk-on-larger.html
[24] http://indianfoodbrands.blogspot.com/2010/02/reliance-dairy-to-market-milk-on-larger.html

Fonterra Co-operative Group, a global leader in dairy nutrition, the Indian Farmers' Fertilizer Co-operative (IFFCO) and Global Dairy Health have signed a Memorandum of Understanding in 2010 to jointly conduct a feasibility study into a pilot dairy farm in India as a first step towards the vision of establishing large-scale world-class dairy farms in India. It is reported that the first phase of the pilot will aim setting up dairy farms with a herd size of 3,000 to 5,000 cows. This is similar to its venture in China in 2007. The Karnataka milk federation has been planning to set up a plant for manufacturing cheese in association with Fonterra. It is likely to be a 50:50 joint venture between the two players.[25]

[25] http://www.fnbnews.com/article/detnews.asp?articleid=29763&sectionid=40

4.6 STRUCTURAL CHANGES IN CONSUMPTION OF MILK AND MILK PRODUCTS

Sustained economic growth, fast-growing urban population along with changing lifestyles, and increasing consumer concerns for food safety and quality are leading to a significant shift in food basket in India. Several studies have shown that in the recent years the while per capita consumption of food grains stagnated, rapid increase in consumption of high value horticultural and livestock food commodities has been witnessed (Kumar *et al* 2003; 2006; 2007). Milk has emerged as one of the most significant components of food consumption basket of India. However, research concerning India's food consumption continues to be focused on basic foods (mainly foods of plant origin) while the demand for foods of animal origin like milk are inadequately understood. An in-depth understanding of the dynamics of milk and milk products consumption for developing economies like India is important not only for academic exploration but also for policy formulation. There are a limited number of earlier attempts that looked specifically into consumption of milk and milk products. However, none of these studies provide a comprehensive picture of milk consumption in India and they are also quite dated. An evaluation of milk consumption pattern along with its response to changes in income and prices is important for the planners and policy makers. The demand projections for milk will be helpful for developing effective and strategic development options for sustainable growth of Indian dairy sector. In this backdrop, this study was undertaken to examine the trends in milk consumption pattern and estimate the demand and supply of milk in India.

4.6.1 Trends in Consumption of Milk and Milk Products: Rural-Urban Disparities

There has been a considerable shift in the food consumption pattern in India and the share of high value commodities has been consistently increasing in the food budget of Indian households. The share of milk and milk products accounted for about 14 per cent of the household food expenditure, up from 8 per cent in 1983. The increasing share of milk and milk products in household food expenditure is reflected in the increase of per capita consumption of dairy products in India. The per capita consumption of milk increased from 43kg in 1983 to 57kg in 2009-10 (Table 4.30).

Table 4.30: Per capita consumption and expenditure of milk and milk products in India

	Consumption(kg/annum)			Expenditure(Rs./annum at constant prices 1993-94)		
Years	Rural	Urban	All	Rural	Urban	All
1983	38.7	55.6	44.7	238.5	434.0	282.6
1993-1994	50.3	66.4	54.3	325.0	546.0	379.8
2004-2005	50.2	69.3	55.0	311.0	547.5	370.9
2009-2010	51.7	71.6	57.1	380.9	900.6	453.4

Source: NSSO (various round)

The per capita consumption of milk has remained higher in urban areas. In 1983, the average annual per capita milk consumption of rural households was 39 kg which increased to 51.7 kg in 2009-10. During the same period, the annual per capita consumption of dairy products of urban households increased from 55.6 kg to 71.6 kg. The comparison of the consumption rates of rural and urban populations overtime revealed that the gap between the rural and urban consumption patterns are bridging. However, even in 2009-10, the per capita consumption of dairy products in urban households was 38 per cent higher than their rural counterparts. This implies that urbanization would continue to be an important source of growth in the demand for dairy products, but sustained growth in rural per capita income would also be critical to accelerate growth in the demand for dairy products.

4.6.2 Relationship between Income and Consumption

Understanding the relationships between consumption and income change is very important. Generally, income is considered being the most important factor determining per capita food demand

(Cranfield *et al.* 1998; Guo *et al.* 2000; Regmi *et al*. 2000; Gould 2002; Jones *et al.* 2003; Zhou *et al.* 2005; Tian and Zhou 2005; Wang and Zhou 2005). The relationship between consumption and income is often referred to as the Engel curve (Timmer, Falcon and Pearson 1983; Hirshleifer, Glazer and Hirshleifer 2005). To examine this, data on food consumption quantities reported by consumers of different income levels (or classes) are presented in Table 4.31. The consumption of milk and milk products depicted a direct relationship with the income levels. The gap between the consumption level of very poor households and the rich households are glaring. In 1983, the per capita consumption of milk by rich households was almost eleven times more than that by the poor households. However, the consumption of milk registered a significant increase in all categories of households. The highest increase in the consumption of milk was recorded by the very poor households. In fact, the growth in consumption of milk depicted an inverse relationship with income. The gap in the per capita consumption of milk by the rich and poor households slightly reduced overtime and in 2009-10, the per capita consumption of milk by rich households was seven times than that of very poor households and four times of the poor households.

Table 4.31: Per capita consumption of milk and milk products in India (kg/annum)

Years	Very poor	Poor	Non-poor	Rich
1983	10.3	22.5	40.4	88.2
1993-1994	13.3	26.8	48.5	101.5
2004-2005	14.1	24.7	42.4	86.7
2009-2010	13.7	28.3	49.9	93.3

Source: NSSO (various round)

4.6.3 Regional Patterns of Consumption

There are considerable differences in the consumption of milk across different states. It is as low as 14.5 kg in Chhattisgarh to as high as 160.5 kg in Haryana in 2009-10. Besides Haryana, the consumption of dairy products was very high in Punjab (140.7 kg), Rajasthan (125.4 kg), Himachal Pradesh (121.4 kg), Gujarat (84.6 kg) and Uttarakhand (83.9 kg). The per capita consumption of dairy products ranged from 40-60 kgs in Kerala (41.3 kg), Andhra Pradesh (46.7 kg), Maharashtra (48.9 kg), Tamil Nadu (49.7 kg), Karnataka (53.3 kg), Madhya Pradesh (53.7 kg), and Uttar Pradesh (59.3 kg). The per capita consumption of milk was low in Odisha (16.4 kg), Assam (20.8 kg), West Bengal (21.9 kg), Jharkhand (26.5 kg), Bihar (34.9 kg) etc. However, the milk and milk consumption increased during this period in all the states except Assam, Chhattisgarh and West Bengal. The increase was the highest in Tamil Nadu (70.1%) followed by Jharkhand (66.4%), Kerala (47.3%), Rajasthan (45.1%), and Odisha (39.3%) (Table 4.6.3). The Compound annual growth rate in milk consumption varied from 0.6 per cent to 2.1 per cent. The regional disparities in consumption of milk and milk products continue to persist though the magnitude of disparities seems to have declined. The coefficient of variation in consumption of milk declined from 81.8% in 1983 to 77.4% in 2009-10. The regional disparities in the consumption pattern of milk and milk products can be explained partly by socio-cultural and economic factors.

Table 4.32: Per capita consumption of milk and milk products in different states

(Kg/annum)

States	1983	1993-94	2004-05	2009-10	Change between 1983 and 2009-10 (%)
Andhra Pradesh	34.7	39.0	43.5	46.7	34.6
Assam	24.6	17.2	22.1	20.8	-15.4
Bihar	25.8	31.9	38.3	34.9	35.3
Gujarat	68.6	77.2	74.7	84.6	23.3
Haryana	130.4	164.6	161.5	160.5	23.1
Himachal Pradesh	92.2	96.8	111.7	121.4	31.7
Karnataka	38.8	42.5	48.0	53.3	37.4
Kerala	27.9	34.7	41.4	41.0	47.0
Madhya Pradesh	42.6	41.1	53.9	53.7	25.8
Maharashtra	38.3	41.8	44.5	49.0	27.9
Orissa	11.8	12.5	13.6	16.4	39.0
Punjab	132.0	161.7	141.7	140.7	6.6
Rajasthan	86.4	128.6	119.4	125.4	45.0
Tamil Nadu	29.1	34.0	42.6	49.7	70.8
Uttar Pradesh	46.6	69.8	60.5	59.3	27.3
West Bengal	25.8	24.0	23.2	21.9	-15.1
Jharkhand	16.0	29.7	24.1	26.6	66.3
Chhattisgarh	17.7	22.6	13.4	14.5	-18.1
Uttarakhand	71.2	92.7	84.4	83.9	17.8
India	44.7	54.3	55.0	57.1	27.7
CV (%)	81.8	86.8	79.2	77.4	-5.3

Source: NSSO (various round)

4.6.4 Role of Milk in Protein Intake

Milk and milk products are an important source of protein and calorie for the consumers in both rural and urban areas. While it is the third largest source of protein after cereals and other foods, the percentage protein intake from milk and milk products is much higher than that from meat, egg and fish. Milk and milk products account for 9.3 percent of the protein intake compared to about 4 percent from meat, egg and fish in rural areas. It is higher in urban areas; 12.3 percent of the protein intake is from milk and milk products compared to 5.47 percent from meat, egg and fish (Table 4.33).

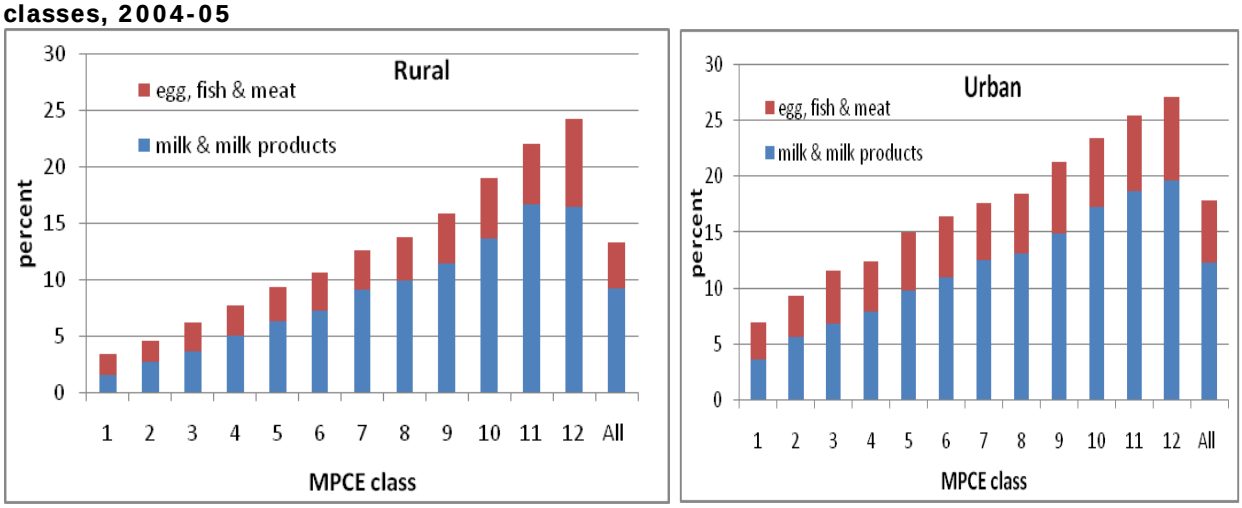
Table 4.33: Percent distribution of protein and calorie intake by food groups, 2004-05

	Rural	Urban	Rural	Urban
	% distribution of total protein intake		% distribution of total calorie intake	
Cereals	66.37	56.16	67.54	56.08
Roots & fibre	-	-	2.95	2.82
Sugar & honey	-	-	4.78	5.69
Pulses, nuts & oilseed	9.47	11	4.98	6.68
Vegetables & fruits	-	-	2.23	3.17
Meat, egg & fish	3.98	5.47	0.76	1.05
Milk & milk products	9.28	12.33	6.42	8.61
Oils & fats	-	-	7.36	10.58
Misc food & products	10.84	14.98	2.98	5.32

Source: NSSO, GoI 2007.

Milk and milk products contribute more toward total protein intake compared to meat, egg and fish and the divergence is greater as one moves up the expenditure classes- from less than 2 percent to nearly 17 percent in rural areas and less than 4 percent to nearly 20 percent in urban areas (Figure 4.16).

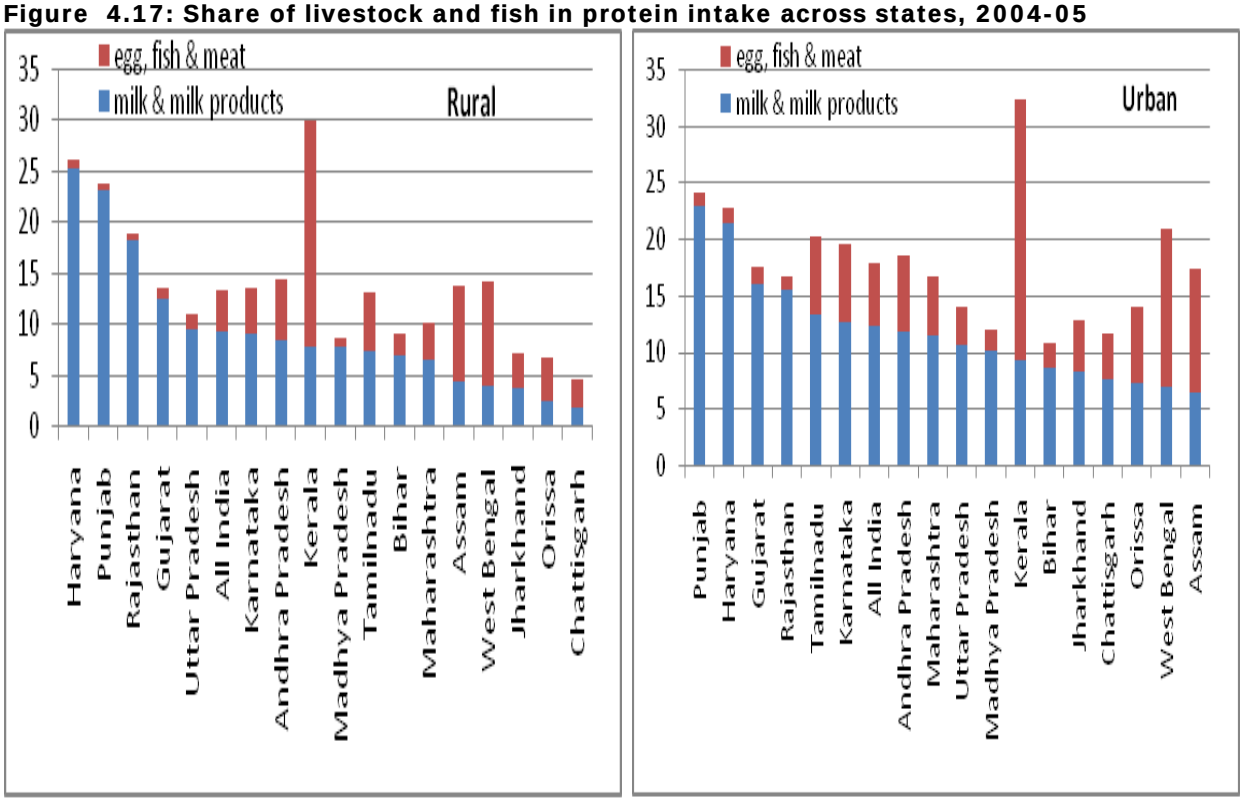
Figure 4.16: Share of livestock and fish products in total protein intake across expenditure classes, 2004-05



Source: NSSO, GoI 2007.

Again across states, Haryana and Punjab lead in protein intake from milk and milk products accounting for more than 20 percent of the protein intake. The share of egg, fish and meat is quite small, less than 1 percent in rural areas and less than 1.5 percent in urban areas (Figure 4.17). In contrast, in Kerala about 22 percent and 23 percent of the protein intake comes from egg, fish and meat diets in rural and urban areas respectively followed by West Bengal at 10.3 percent and 13.8 percent respectively. The patterns of protein intake across states follow the pattern observed in share of per capita monthly expenditures on milk and milk products.

Figure 4.17: Share of livestock and fish in protein intake across states, 2004-05



Source: NSSO, GoI 2007.

4.6.5 Diversity in the Consumption of Milk and Milk Products: Emerging Patterns

Further break up within milk and milk products consumption are given in Table 4.34. Milk and milk products include liquid milk, curd, ghee, butter, ice-cream, condensed milk/powder, baby food and other milk products. The consumption of dairy products is dominated by liquid milk among both in rural and urban consuming households. The changing pattern of milk consumption is reflected in the disaggregate changes in the consumption of milk products. Though, the consumption level of ice-cream is not significant, the change in its consumption between 1993-94 and 2009-10 is tremendous. The expenditure on its consumption registered a whopping increase of 350%.

Table 4.34: Per capita expenditure of milk and milk products in India at 1993-94 prices

	Rural			Urban			All		
	1993-94	2009-10	Change over 1993-94 (%)	1993-94	2009-10	Change over 1993-94 (%)	1993-94	2009-10	Change over 1993-94 (%)
Liquid milk	302.8	360.1	18.9	475.6	785.0	65.1	345.6	415.7	65.1
Curd	1.9	1.9	0.0	5.8	9.6	65.5	2.9	3.3	65.5
Ghee	15.8	13.6	-13.9	49.0	76.2	55.5	24.0	24.8	55.5
Butter	0.5	0.2	-60.0	4.0	3.7	-7.5	1.3	0.8	-7.5
Ice-cream	0.2	0.5	150.0	1.2	7.7	541.7	0.4	1.8	541.7
Condensed milk/powder	2.1	2.4	14.3	6.3	5.8	-7.9	3.1	2.9	-7.9
Baby food	0.9	1.3	44.4	2.9	6.9	137.9	1.4	2.3	137.9

Source: NSSO (various rounds)

The growing health concerns seem to have reduced or stagnated in the per capita consumption expenditure on butter and ghee. The increase in expenditure on consumption of milk and milk products depicted a distinct variation in rural and urban areas. The expenditure on ice-cream increased by 150% in rural areas and 542% in urban areas. In fact, in urban areas, the consumption of all milk products increased faster than that in rural areas during this period.

4.6.6 Demand Projections for Milk in India

The total demand for milk can be divided into two categories. One milk consumed by the household at home in various forms, also referred to as “direct demand”; two milk is used in the industries and the quantity that goes as waste. This is referred as “indirect demand”. Various projections have been made on future demand for milk in India. These projections are based on factors like growth in population and income, income elasticity of demand, own and cross price elasticity, economic trends and policies. These projections vary widely depending on the assumptions and models used. In this study, an attempt has been made to provide credible estimates of future demand for milk by estimating demand at the disaggregated level, in terms of income, lifestyles, and states/union territories (UTs) of India, and the added up estimates so obtained have been used to arrive at the national estimates. Consumption patterns differ across income groups, lifestyles, and geographical locations (regions, sates/UTs). Hence, to capture their effects we have classified 35 states and union territories of India into rural and urban households and 8 expenditure strata- 4 for rural and 4 for urban households – on the basis of poverty line adopted by the Planning commission of Government of India. Demand elasticities, population projections and income growth are the important parameters for projecting future food demand. Thus, the direct household (human) food demand projections were derived by the growths in population, urbanization and income. The magnitude of demand elasticities of a commodity depends largely on the model chosen by the analyst. The demand projections for commodities were obtained using the following model:

$$d_{ijkt} = d_{ijkt-1} (1 + y \times e_{ijk})$$

$$D_{ijkt} = D_{ijkt} \times N_{ijkt}$$

where, D_{ijkt} is the demand for a commodity for the subgroup of 'i' lifestyle (rural, urban) in the 'j' state/UT of 'k' income group (very poor, moderately poor, non-poor lower and non-poor higher) in't' period; d_{ijkt-1} is the per capita consumption for 'i' lifestyle in the 'j' state/UT of 'k' income group in the't-1' base year (2004-05, Appendix 4); N_{ijkt} is the population in 't' year belonging to 'i' lifestyle in 'j' state/UT of 'k' income group; y is growth in per capita income (GNDP growth-population growth) and e_{ijk} is the expenditure elasticity for the subgroup population belonging to 'i' lifestyle in 'j' state of 'k' income group. These regional income elasticities were superimposed on the corresponding state/UT. The aggregate direct household human demand in the year't' will be the sum of i and k (i=1,2: k=1,4) for the 'j' state/UT of India. The sum over state/UT will arrive at the national household demand for milk in the 't'th year.

The national level estimates of income and own price elasticities of milk based on QUAIDS and FCDS model are presented in Table 4.35. These were found to be in accordance with a priori expectation. The income elasticities of milk are positive and decline with increase in household income. The income elasticities are much higher for poor households than for richer households. The own price elasticities had the expected negative sign. Across income groups, the magnitude of own price elasticities is highly correlated with the income elasticities.

Table 4.35: Income and price elasticties of milk in India

	QUAIDS model		FCDS model	
	Income elasticities	Price elasticities	Income elasticities	Price elasticities
Very poor	2.342	-0.820	0.862	-0.850
Poor	2.018	-0.923	0.694	-0.810
Non-poor	1.773	-0.999	0.539	-0.708
Rich	1.556	-1.076	0.276	-0.521
All	1.640	-1.035	0.429	-0.624

Source: Kumar et al, 2011

The income elasticities obtained by the QUAIDS model are considerably higher than that obtained by FCDS model (see Table 4.36). Price elasticity trend with rise in income exhibited a more realistic view under FCDS than under QUAIDS model to explain the consumer behaviour. Therefore, the elasticity derived under FCDS models were used for demand projections of milk in India.

Table 4.36: Demand Projections for milk in India

Year	Household demand	Indirect demand	Total demand
2011-12	68.8	47.5	116.3
2016-17	81.7	56.4	138.1
2021-22	99.4	68.7	168.1
2026-27	123.6	85.4	209.0

Source: Kumar et al, 2011

The next question comes whether the expected milk supply would be able to meet the domestic demand of milk in India. The supply projections under different scenarios indicate that with existing growth rate of milk production during the last decade, India would be self-sufficient in milk ever 2026-27. However, any slow down or deceleration in the milk production growth would jeopardize the self-sufficiency status of milk production in the country. However, if concentrated efforts are made to accelerate the growth of milk production, India can turn out to be an important exporter of milk and milk products. Such demand pressures are likely to increase the demand for feed and fodder and also backend services that are important to augment supply of liquid milk. Although India is the largest producer of liquid milk, and also has a large livestock population, the Indian dairy sector suffers from low productivity of animals, high cost of production. Also a large part of the milk is handled through informal channels varying across states. Structural changes are taking place alol along the dairy chains moving from unorganized to organized chains, and even within the organized sector, private sector overtaking the cooperatives, scaling up activities to benefit from economies of scale. In such an event, increasing demand can offer the right impetus in pushing these big changes.

4.7 COMPETITIVENESS OF MILK PRODUCTION

4.7.1 Economics of Milk Production

Unlike crop sector the comprehensive data on cost of milk production is not available in India. However, a flavor of cost of milk production can be gauged from the studies carried out in different parts of the country. Cost of milk production in India is one of the lowest in world, from 0.14 to 0.16 US cents per kilogram. (Hemma *et al*., 2003). However, the cost of milk production varies across sizes and also across regions. Similarly the cost of milk production varies across seasons also.

To assess the profitability of milk production, the associated costs incurred, including marketing costs was worked out and then deducted from the gross price received per litre of milk. The return to family labour was also quantified along with margin for proper understanding of the economics of milk production. The average dairy milk yield was 6.11 litres in Uttar Pradesh while those of Bihar and Punjab were respectively 4.19 litres and 6.35 litres (Table 4.37. The cost of milk production in the Indo-Gangetic plain was about 18.6 Rs/litre. The cost of milk production varied across state. It was the highest in Punjab followed by Uttar Pradesh and Bihar. The lower cost of production in Bihar is mainly because of the less intensive dairy farming practiced here wherein they save on more expensive feeds like concentrates. The marketing costs were found to be negligible in all three areas under study. The results suggested that, the milk producers in Punjab are deriving maximum profits as compared with those of Uttar Pradesh and Bihar and their margins were respectively Rs. 4.3, Rs. -0.5 and Rs. 2.0 per litre of milk sold. The farmers in Bihar realized lesser profits even with lower cost of production because they received lower prices from the buyers to whom they sell maximum amount of milk. The farmers in Punjab also realized highest returns to family labour which amounted to Rs. 7.6 per litre of milk production. The above analysis suggests that milk production is quiet a profitable proposition with high returns to labour. Large scale production of milk can bring in economies of scale which would further reduce costs resulting in higher returns. The cost of milk production has been estimated by Saravana kumar and Jain, 2009 to about Rs 19.7 per litre in 2009-2010 up from Rs 10.1 in 2002-2003.The estimated annual growth in cost of milk production at constant 2004-2005 price was reported to be 6.5 percent.

Table 4.37: Economics of milk production in India

	Bihar	Punjab	Uttar Pradesh	All
Yield (Kg./day)	4.2	6.4	6.1	5.9
Cost of milk production (Rs./litre)	19.2	19.7	17.6	18.6
Cost of selling milk (Rs./ litre)	0.0	0.0	0.1	0.1
Price of milk (Rs./ litre)	18.7	24.0	19.7	21.3
Margin (Rs./ litre)	-0.5	4.3	2.0	2.6
Return to family labour (Rs. per litre)	5.9	7.6	6.3	6.8

Source: Milk producers survey, 2007

The break-up of cost of production of milk is depicted in Table 4.38. The results suggest that a major proportion of amount spent for milk production is set apart for feeds and fodder. In Uttar Pradesh, around 73.4 per cent of the total operational expenses are towards feeding charges, of which concentrates claim the highest share (36.2). In Bihar and Punjab also the expenses towards concentrates and fodder were higher in comparison to other expenses and were 60.5 per cent and 80.1 per cent respectively. The higher milk yield of Uttar Pradesh and Punjab farmers can be substantiated with their higher spending on concentrates.

Table 4.38: Structure of cost in milk production (Per cent)

Particulars	Bihar	Punjab	Uttar Pradesh
Dry fodder	26.5	34.9	27.9
Green fodder	6.5	7.8	9.3
Concentrates	27.5	37.4	36.2
Transaction cost in input procurement	0.7	1.1	1.2

Family labour	33.7	16.6	24.6
Hired labour	4.1	1.4	0.1
Veterinary expenses	1.0	0.7	0.6
Total cost incurred	100	100	100

Source: Milk producers survey, 2007

Most of the farmers relied on family labour rather than hired labour and the fact is reflected from the relative shares of expenditure on them. The transaction costs in input procurement and veterinary expenses were minimal in all the three areas of study.

The evidence on relationship between cost of milk production and size is mixed. Some of the studies have shown that the cost of milk production increases with size implying that small holders are more competitive in milk production, though the variation across different categories of famous farmers are negligible. In our study, there was not a clear relationship between scale and economics of milk production (Table 4.39). The milk yield seems to have a positive relationship with the scale however; the differences in milk yield could not clearly influence the economics of milk production.

Table 4.39: Economics of milk production vis-à-vis size of the farm

Land class	Yield (Kg./day)	Cost of milk production (Rs/litre)	Price of milk (Rs/ litre)	Margin (Rs/litre)	Retrun to family labour (Rs/litre)
Landless	4.6	22.1	21.5	-0.6	6.2
Marginal	5.2	20.9	20.9	0.0	5.3
Small	5.8	18.3	21.3	3.1	7.3
Medium	6.4	17.1	21.2	4.1	7.4
Large	6.7	17.3	21.6	4.3	7.4

Source: Milk producers survey, 2007

4.7.2 Competitiveness of Indian Dairy Sector

India has a competitive advantage in production of milk. Producer prices of milk are lower in India than in the leading international exporting countries (Table 4.40). In fact, the producer price of milk in India increased relatively less than the other leading countries. The price advantage of India vis-a-vis other leading countries enhances its prospects of export of milk to the SAARC, most of which are deficient in meeting their domestic requirements.

A comparison of producer prices does not reveal the real strength of export competitiveness as these do not take into account several functional expenditures like freight charges, insurance costs and port handling charges. To account for these expenditures, Nominal Protection Coefficients (NPCs) were computed.

Table 4.40: Producer prices of milk in India vis-à-vis major exporters of the world

(US$/tonne)

Country	TE 1993	TE 2002	TE 2009
India	227	240	303
France	358	297	455
Germany	383	299	426
Australia	210	156	334
Denmark	415	312	469
US	283	290	372
New Zealand	139	171	331

Source: Base data are from FAOSTAT

The indicators for export competitiveness for dairy products suggest that the Indian dairy industry has been protected from the distorted world prices. The value of NPCs hovered around 1.02 to 1.25 for

SMP and 1.15 to 1.27 for WMP (Table 4.41). The NPCs for SMP and WMP were 0.72 and 0.83 respectively in 2007 due to high spurt in international prices of these commodities. The price increase for these commodities in 2007 was relatively less as compared to world market. However, these figures do not inspire much confidence for India to record significant export of these commodities under the existing world prices. India can emerge as significant exporter by subsidizing its own exports to compete with other exporters or negotiate in the WTO for substantial reduction in subsidies by the major exporters of WMP and SMP (Rakotoarisoa and Gulati 2006). But the possibility of export of butter does not exist. The NPC for butter was 1.98 in TE 1993 and reached to 2.59 in TE 2002 and then depicted a declining trend went down to 1.77 in TE 2007. This implies that butter prices have been possibly more protected than of SMP and WMP or the world market prices for butter has been heavily subsidized.

Table 4.41: Nominal protection coefficients of dairy products

Period/Item	Exportable hypotheses			Importable hypotheses		
	Butter	WMP	SMP	Butter	WMP	SMP
TE 1996	1.87	1.16	1.06	1.79	1.13	1.04
TE 1999	2.15	1.27	1.25	2.02	1.21	1.18
TE 2002	2.59	1.16	1.02	2.37	1.11	0.98
TE 2005	2.14	1.26	1.14	2.03	1.23	1.11
TE 2007	1.77	1.15	1.02	1.72	1.14	1.01

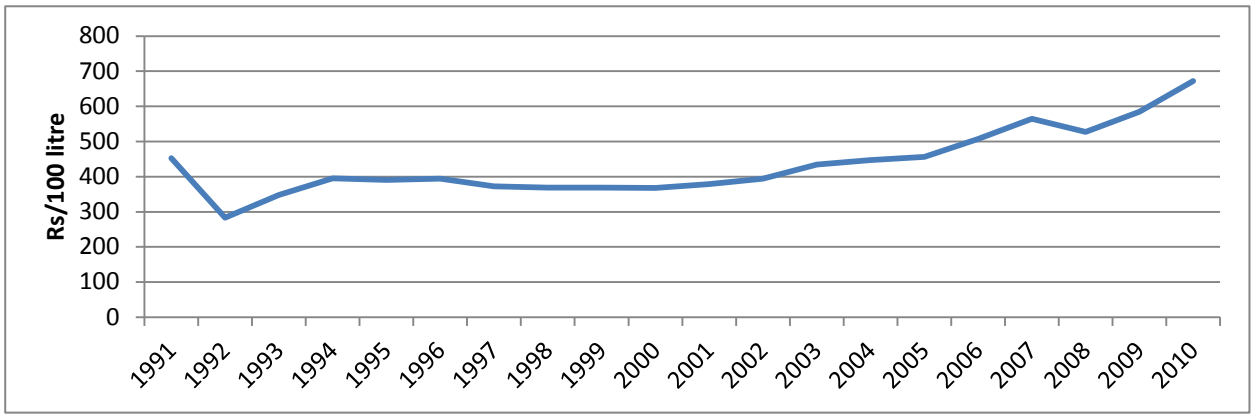
Source: Kumar and Rai, 2011

4.7.3 Trends in Prices

There has been a consistent rise in domestic prices of milk during the past two decades .Between 1991 and 2010, the domestic price of milk has increased at an annual growth rate of about 3 percent. However, the trend in domestic price of milk exhibits different pattern during 1990s and 2000s.The milk price in the domestic market during 1990s virtually stagnated but rose sharply at about 6% per annum in the post 2000 period.

The domestic price of butter registered an annual growth rate of 1.2 percent during 1990s and increased slightly from USD 2479 per tonne in TE 1993 to USD 2607 in TE 2001. However, the growth in domestic price of butter accelerated afterwards and registered a whopping annual growth of 6.2 percent between 2001 to 2010 and reached to about USD 4130 per tonne in TE 2010.The international prices of butter exhibits variable trends. It slightly declined during 1990s from USD 1483 per tonne in TE 1993 to USD1276 per tonne in TE 2001 (see Figure 4.18).

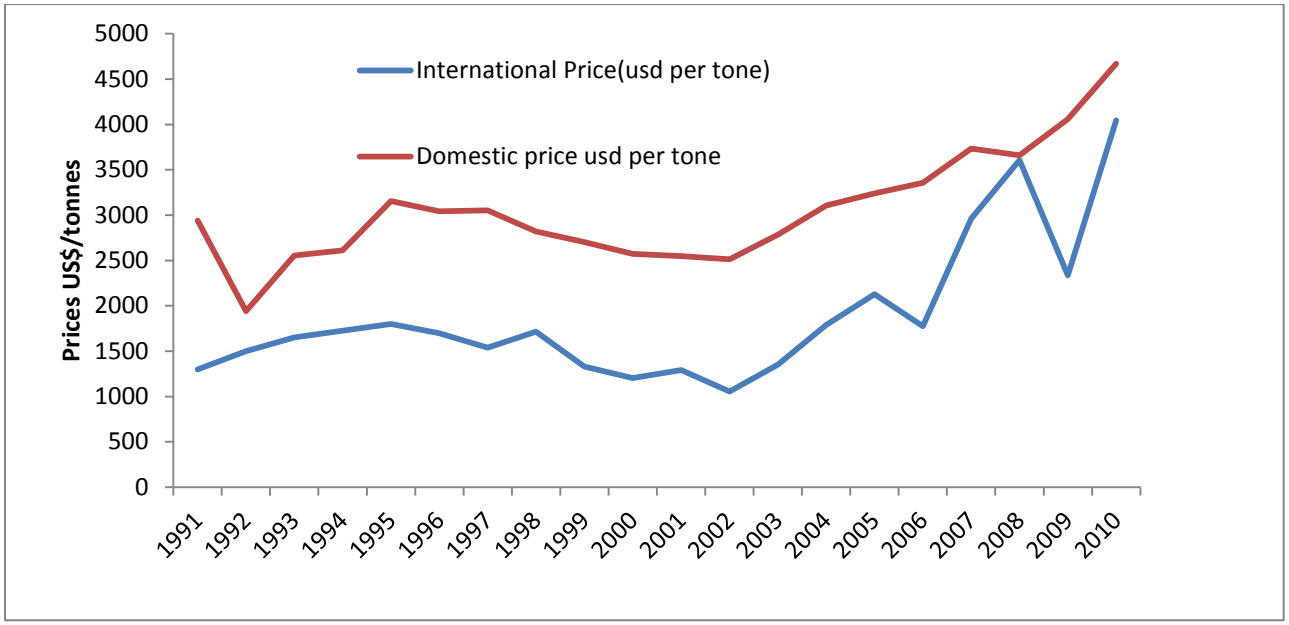
Figure 4.18: Trends in domestic prices of milk



Source: Office of Economic Advisor, Government of India 2011

The declining trend continued till 2002.Afterwards, it started firming up and the international price of butter registered an annual growth of a whopping 13.2 percent during 2001 to 2010 and the international prices of butter rose to USD 3328 in TE 2010 (Figure 4.19).

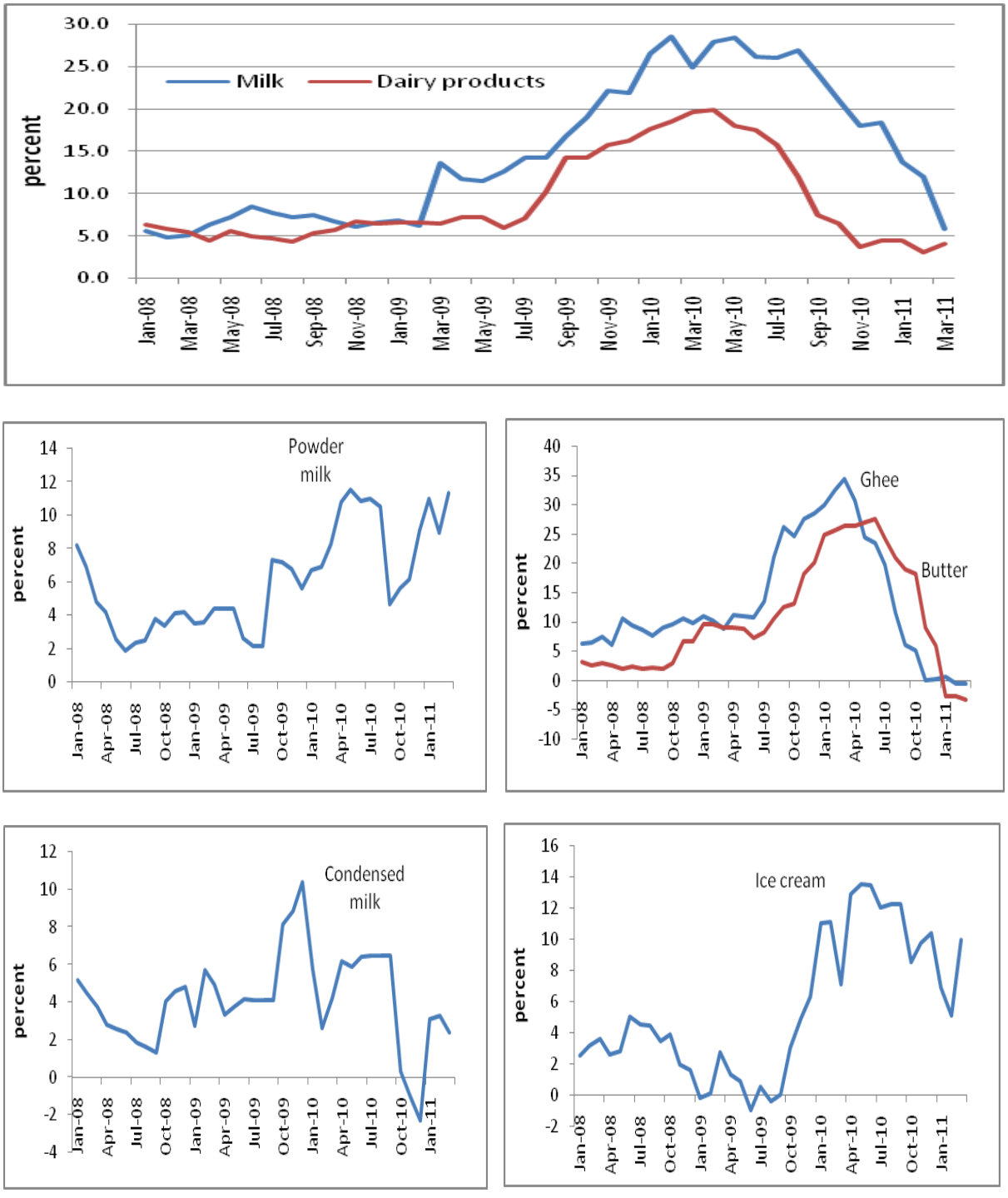
Figure 4.19: Trends in national and domestic prices of butter



Source: Office of Economic Advisor, Government of India 2011 and FAO stat

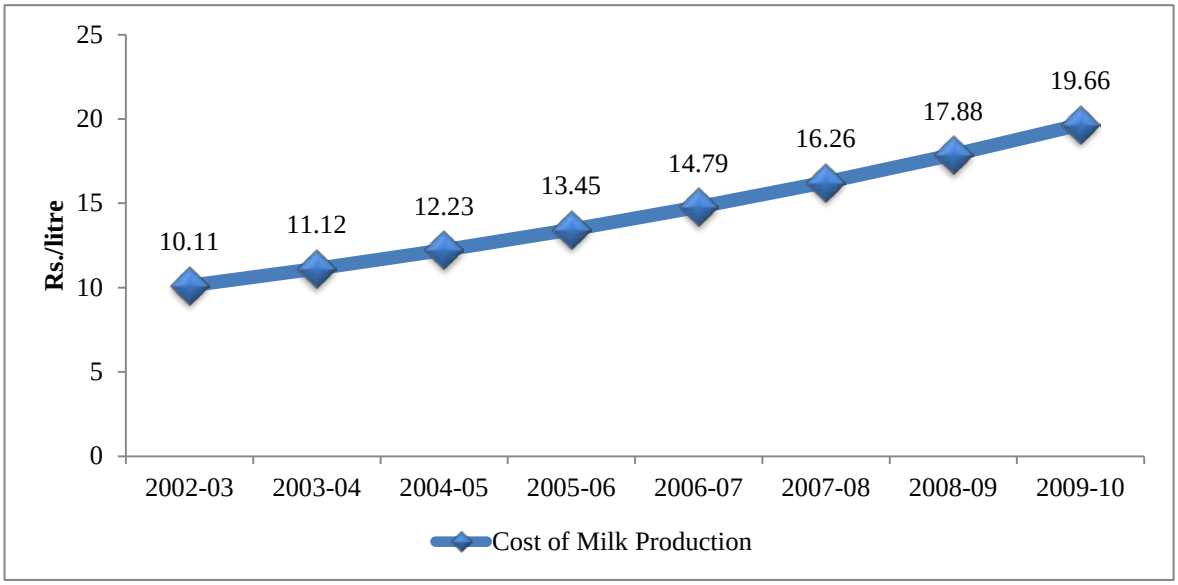
The trends in prices of milk and milk products indicate that of late prices of milk and milk products have been increasing consistently indicating increasing demand pressures on supply of milk. Cost of milk production is also estimated to have gone up going to increases in price of feed and fodder among other things (Figure 4.21). The recent trends in milk and milk products are depicted in Figure 4.20. The wholesale price index of milk (at 2004-05 prices) nearly doubled (13.7 percent) in March, 2009 over March, 2008 and thereon continued in double digits peaking in February, 2010 at 28.5 percent. The beginning of 2011 marked a decline in the price pressure and the wholesale price declined to 5.8 percent in March, 2011 over March, 2010 (Figure 4.20). The wholesale price index of dairy products surged during August, 2009 to July, 2010 after which it smoothened and is 4.1 percent in March. 2011. Among dairy precuts, ghee and butter prices increased more than other commodities during the above period and have recorded a negative growth in the beginning of 2011 calendar year.

Figure 4.20: Wholesale price index (2004-05) - percentage change month over month (of the corresponding year) of dairy products



Source: Office of Economic Advisor, Government of India 2011

Figure 4.21: Trends in cost of milk production



Source: Saravanakumar and Jain, 2009

4.8 ROLE OF TRADE AND INVESTMENTS IN DAIRY SECTOR

4.8.1 Dairy Trade Policy

Trade policy plays an important role in the economic development of a country. India's trade policies have witnessed several changes after independence. Till the early -1980s, India pursued highly regulated trade regimes. In 1991, it introduced a new economic policy in the wake of an alarming increase in its external debt, rapidly deteriorating balance of payment (BOP) position, high rate of inflation, mounting fiscal deficits and deceleration in GDP growth. The economic reforms initiated in 1991 were aimed at restructuring the Indian economy, and facilitating greater integration with the world economy. Trade liberalization was directed at quick resumption of export growth and increased exposure of domestic products to external competition. During the initial years, the economic reforms were mainly focused on the industrial sector and agricultural sector reforms were not attempted seriously. However, the indirect effect of changing macro-economic policies was visible on Indian agriculture (Storm, 1997).

The liberal trade policy regime was triggered as an outcome of external developments such as the WTO-UR agreements and endorsement of liberal policy regime internally. India signed the Uruguay Round of Agreement on 15 April.1994 at Marrakesh (Morocco). This treaty introduced agricultural trade in the WTO for the first time. The WTO Agreement on Agriculture came into effect from 1 January, 1995. This marked a paradigm shift in the agricultural trade policy of India. The subsequent trade policy reforms addressed the agricultural sector explicitly and most of the restrictions on both exports and imports of agricultural produce were gradually relaxed.

Agricultural exports and imports were regulated through quantitative restrictions, such as quotas and licenses or were channeled through a state trading organization or some combination of both till early-1990s (Nayyar and Sen., 1994: Kumar *et al* 2001). Exports of milk and milk products were totally prohibited earlier, but later on, the exports of milk, baby milk and sterilized milk are permissible, subject to the licensing requirements. The export of powdered milk, prohibited earlier, was canalized through the NDDB, Anand and was decanalized subsequently. Restrictions on butter exports have been similar to those for powdered milk and quota restrictions were removed from March 2002. The export of ghee was subjected to quantitative restrictions in the 1980s, followed by canalization through NDDB and finally, decanalized. Presently, no minimum export price restriction exists for the export of dairy products. Sometimes India issues ad-hoc prohibitions also on exports of sensitive products. For example, recently export prohibitions have been issued for export of milk powders when exports were banned in February 2007, but were lifted in October 2007.

The sanitary and phyto sanitary (SPS) standards are governed and enforced through a number of laws and agencies in India. The prevention of food adulteration Act 1954 is the main law on Food safety and Food quality, and it takes into account the livestock commodities also. Imports and quarantine are regulated through other additional legislations too. Implementation of these acts and subordinate legislation is carried out by different central government ministries, making the system a relatively complex. India's inquiry points under the SPS Agreement are: Ministry of Health and Family Welfare for human health related issues, Department of Animal Husbandry, Dairying and Fisheries for animal health and Department of Agriculture and Cooperation for plant health issues.

The multiplicity of laws and regulations leads to overlapping and lack of coordination among implementation agencies. Therefore to streamline SPS procedures and their enforcement, the food safety and standards Act was passed by the Indian Parliament in August 2006. This act consolidates 13 laws and establishes a Food Safety and Standards Authority of India (FSSA). The regulations and rules to implement the Act are under formulation. Imports of livestock and meat products are regulated, respectively, under the livestock importation act 1898 (amended last in 2001) and the meat products order (MFPO), 1973 and require an import permit issued by the Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture.

To ensure quality and safety of food commodities, India has been following quality control and pre-shipment inspection prior to their exports. Under the export (Quality control) and inspection) Act 1963, the Export Inspection Council of India (EIC) carries out quality control and pre-shipment inspection to ensure the minimum standards for exports. The Act empowers the central government to notify commodities along with minimum standards for their exports. Although more than 1000 products have been notified for export certification, it is mandatory only for fish and fish products, dairy, poultry, egg, meat and meat products and honey. The EIC has five export inspection agencies (EIAs) located

across major cities in India, supported by 38 sub offices and laboratories to carry out the pre shipment inspection and certification. They also issue preferential certificates of origin for exports as required.

EIC main system of export inspection and certification include; consignment –wise inspection (CWI), a system based approach for in process quality control (IPQC), self-certification (SC) and food safety management systems based certification (FSMSC). Residue monitoring plants (RMPs) have been set up in various sectors which include dairy, poultry, marine, egg products, and honey .Over 98 % of the certified food exports by value are covered in by mandatory export certification under the FSMSC system. The FSMSC is based on international standards for food safety management, such as HACCP/GMO/GHP and involves approval and surveillance of food processing units. The EICs certification has been recognized for a range of food and non-food products. Most of the major importing countries, particularly for dairy products and eggs, insist on food safety system such as HACCP/GMP/GAP and therefore, milk processing plants, egg powder manufacturing units and meat processing plants are approved on the basis of compliance with HACCCP standards. EIC levies a charge of 0.2 percent of F.O.B. for inspection and approval of the processing plants. To strengthen infrastructure for processing of milk and milk products and to ensure availability of hygienic and safe dairy products in domestic as well as export markets, the ministry of food processing (GOI), provides financial assistance by way of grant-in aid, which covers 25 % of the capital cost. Specifically for exporting dairy products to EU countries, the processing has to be done at the EU approved milk processing products in India .About 69 milk processing plants in India have been approved for export of milk and milk products to EU. The provision of regular monitoring by EU exports is also in place. However, India imposes export restrictions and prohibitions for environmental, food security, marketing, pricing and domestic supply reasons. Since 2007, several milk commodities have been subject to export prohibitions, which include milk products like milk powder, casein and its derivatives.

Table 4.42: Import duties on milk and milk products India (Per cent)

	INDIA		
Year	All Milk Products(except SMP and WMP)	Skimmed Milk	Whole Milk
1990	55	55	55
1995	40	0	0
2000	44	0	0
2005	30	30	30
2010	30	30	30

Source: Kumar, 2009

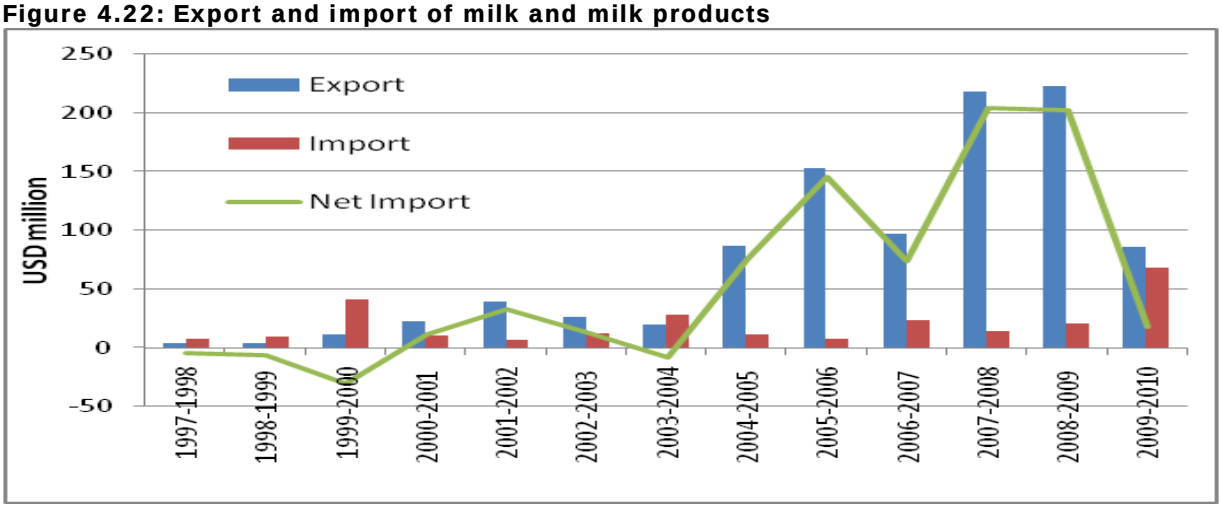
Tariffs on most of the milk products were brought down considerably, consequent to domestic reforms and WTO agreements (Table 4.42). The import tariff was 55 percent for dairy products. It has been gradually reduced and brought down to 30 percent for all the dairy products. However, the surge in import of milk products, especially skimmed milk powder (SMP) in the subsequent years, forced the government to renegotiate at WTO during 2000-01 and fixed Tariff Rate Quota (TRQ) for skimmed milk powder (SMP) and whole milk powder (WMP). The tariff on imports up to 100 percent duty outside TRQ. It may be mentioned here that for SMP and WMP, the import duty was nil at one time. A number of other duties and changes like additional custom duty, education cess are also levied on the imports of milk and milk products. The average applied total duty on dairy products turned out to be 39.7% varying from 30.9% to 68.3% (WTO, 2011). The gaps indicate the extent of leverage available to the government for upward adjustment of the tariff rates to manage imports as per domestic needs. This degree of freedom l also helps to prevent sudden surge in imports of sensitive products and to some extent offsets the dumping of produce by the exporting countries. However, frequent changes in the tariff rates may create an environment of uncertainty for the importers as well as exporters. Apart from reforms in the tariff policy, after the removal of the quantitative restrictions on most of the approved commodities, a mechanism was set up to monitor imports of sensitive items. The list of sensitive items increased from 300 to 415 and milk and milk products figure prominently in this list.

4.8.2 Trade Patterns in Milk and Milk Products

Trade in milk and milk products have increased over time and India has been a net exporter for most of the years since 1997-98. However the patterns of export and import of milk and milk products have

been somewhat volatile. Also, despite being the largest producer of liquid milk, India is a relatively smaller player in the international market. Domestic demand for milk and milk products have grown over time indicating changes in consumption patterns and preferences. Rising demand patterns together with increasing costs of milk production have triggered rise in milk prices .Between 2003-04 and 2008-09, exports increased sharply from USD 20.3 million to USD 223 million. However, the exports of dairy products from India declined and imports of the same increased in 2009-10 (Figure 4.22).

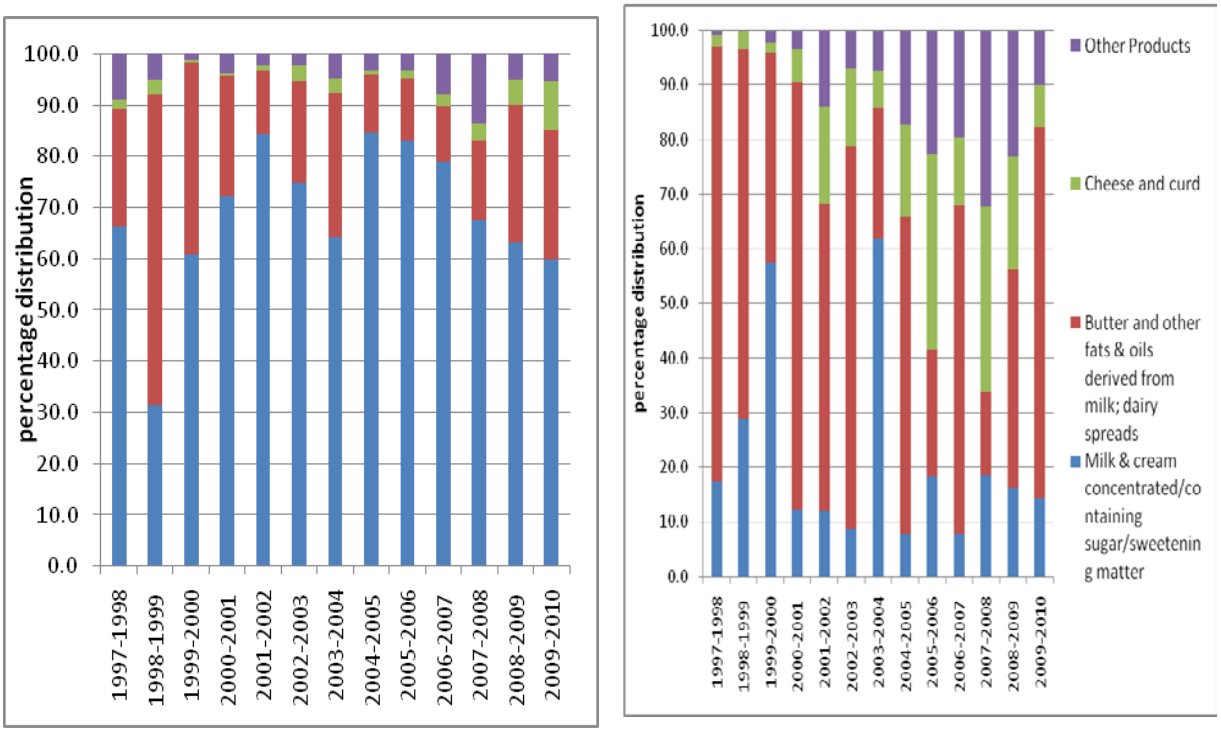
Figure 4.22: Export and import of milk and milk products



Source: Ministry of Commerce, GoI, 2011.

The key products traded (both exported and imported) are milk and cream (concentrated and containing sugar and sweetening matter) and butter and other fats and oil derived from milk and dairy spreads. While the two product groups together account for more than 80 percent to 97 percent of the milk products traded (except for a few years of import), the trends are somewhat mixed (Figure 4.23).

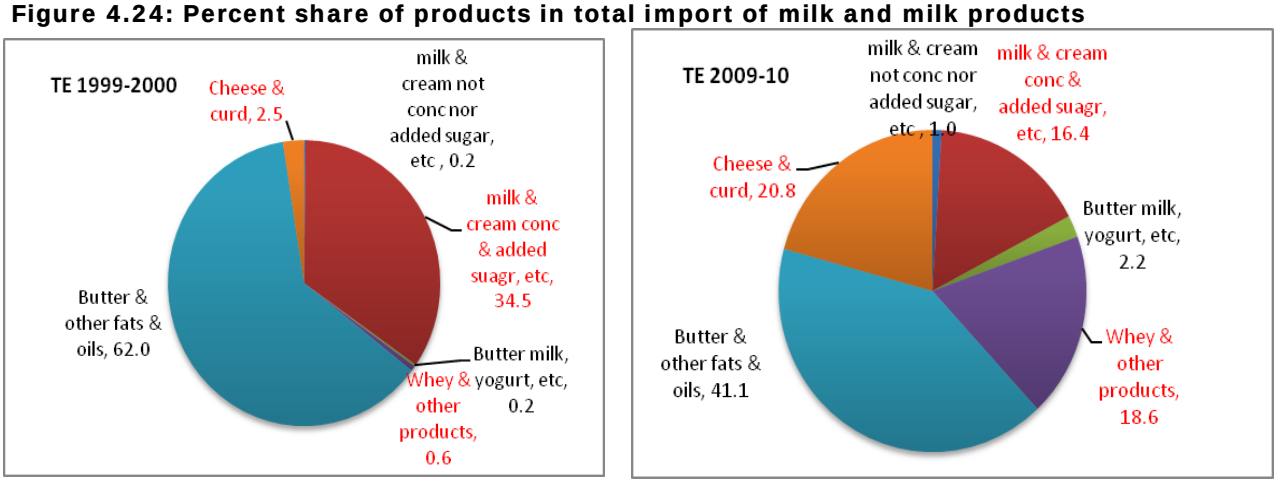
Figure 4.23: Percentage distribution of products: (a) export (b) import



Source: Ministry of Commerce, GoI, 2011.

Emerging market demand for cheese in India is reflected in the growing imports of cheese and curd (as one product group but largely cheese). Imports of cheese and curd increased from USD 0.18 million in 1997-98 to USD 5.3 million in 2009-10. The share of cheese and curd in total imports of dairy products increased from 2.2 percent to 7.7 percent during the above period and touched a peak of 36 percent in 2005-06. Also, in less than a decade, share of cheese and curd in import of dairy products increased from 2.5 percent to nearly 21 percent (Figure 4.24). During this period, export of cheese increased from less than 2 percent to almost 6 percent.

Figure 4.24: Percent share of products in total import of milk and milk products

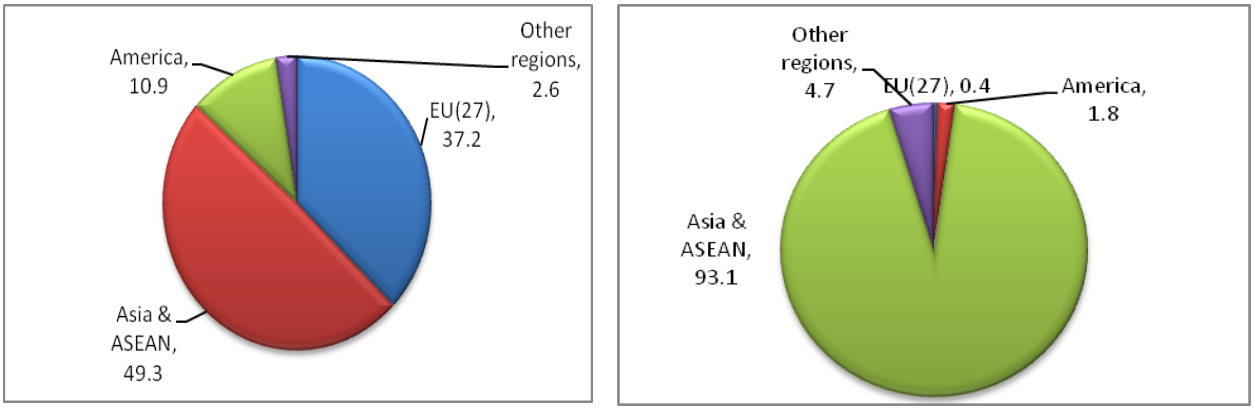


Source: Ministry of Commerce, GoI, 2011.

4.8.3 Key Trade Destinations of Indian Milk and Milk Products

Asia and ASEAN (including Australia and New Zealand) is the key destination for export and imports of milk and milk products (Figure 4.25). It accounts for nearly 50 percent of the imports by India and 93 percent of the exports from India in TE 2009-10. Imports from Asia and ASEAN have increased between 2007-08 and 2009-10 from 28.3 percent to 69.1 percent and that from EU (27) has declined from 54.3 percent to 21.5 percent during this period.

Figure 4.25: Key (a) import and (b) export destinations (region-wise) for Indian dairy products, TE 2009-10



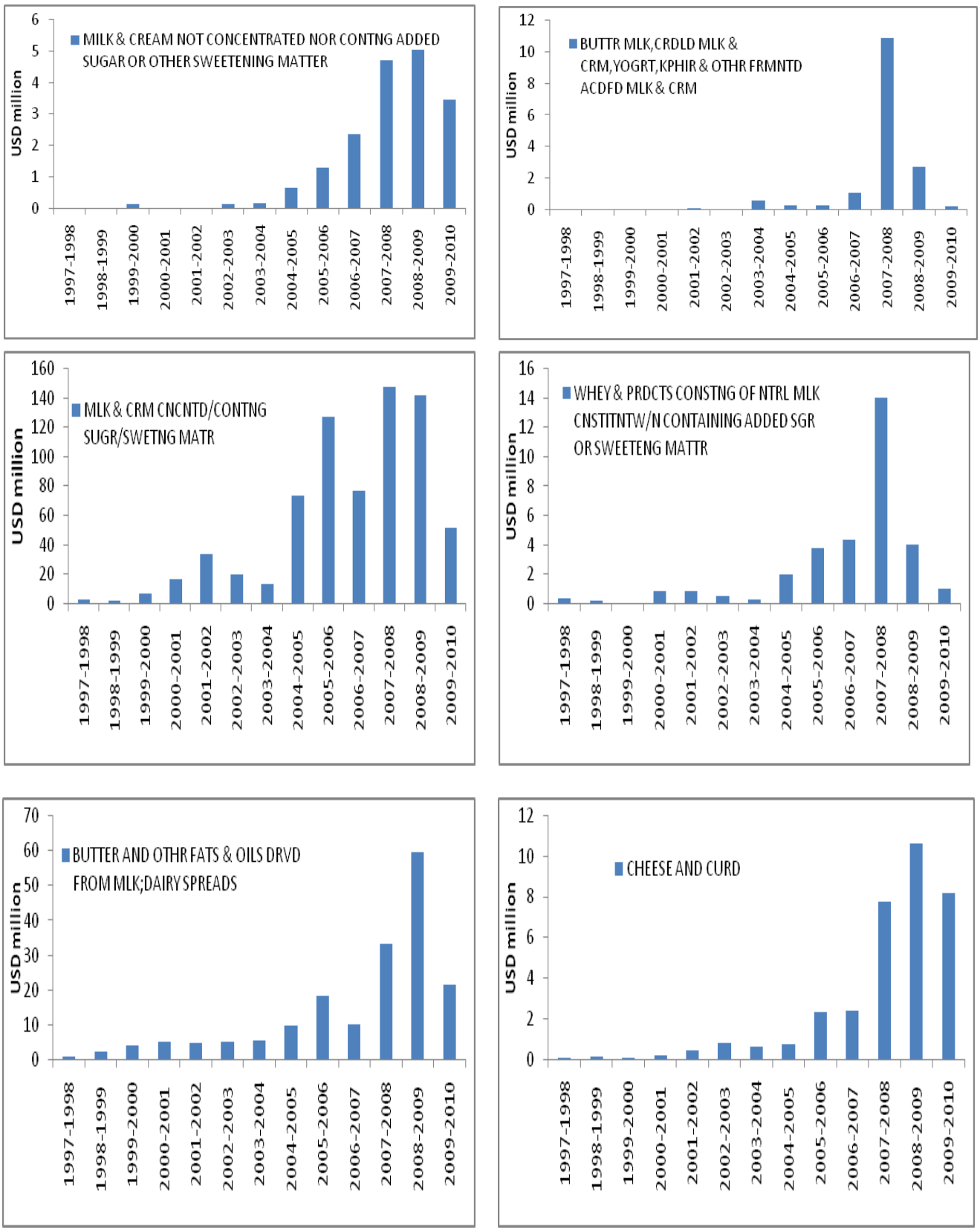
Source: Ministry of Commerce, GoI 2011

Among the Asian countries, Bangladesh, UAE, Singapore, etc are the top export destinations for India. Of the most exported dairy product, Bangladesh accounted for nearly 21 percent of milk and cream (concentrated or containing sugar or added sweetener) during TE 2009-10. UAE accounted for nearly 28 percent of butter and other fats and oils exported from India during TE 2009-10. Trade between

the countries in the region is of interest to reach out supplies to some of the milk deficit countries from ones which are surplus.

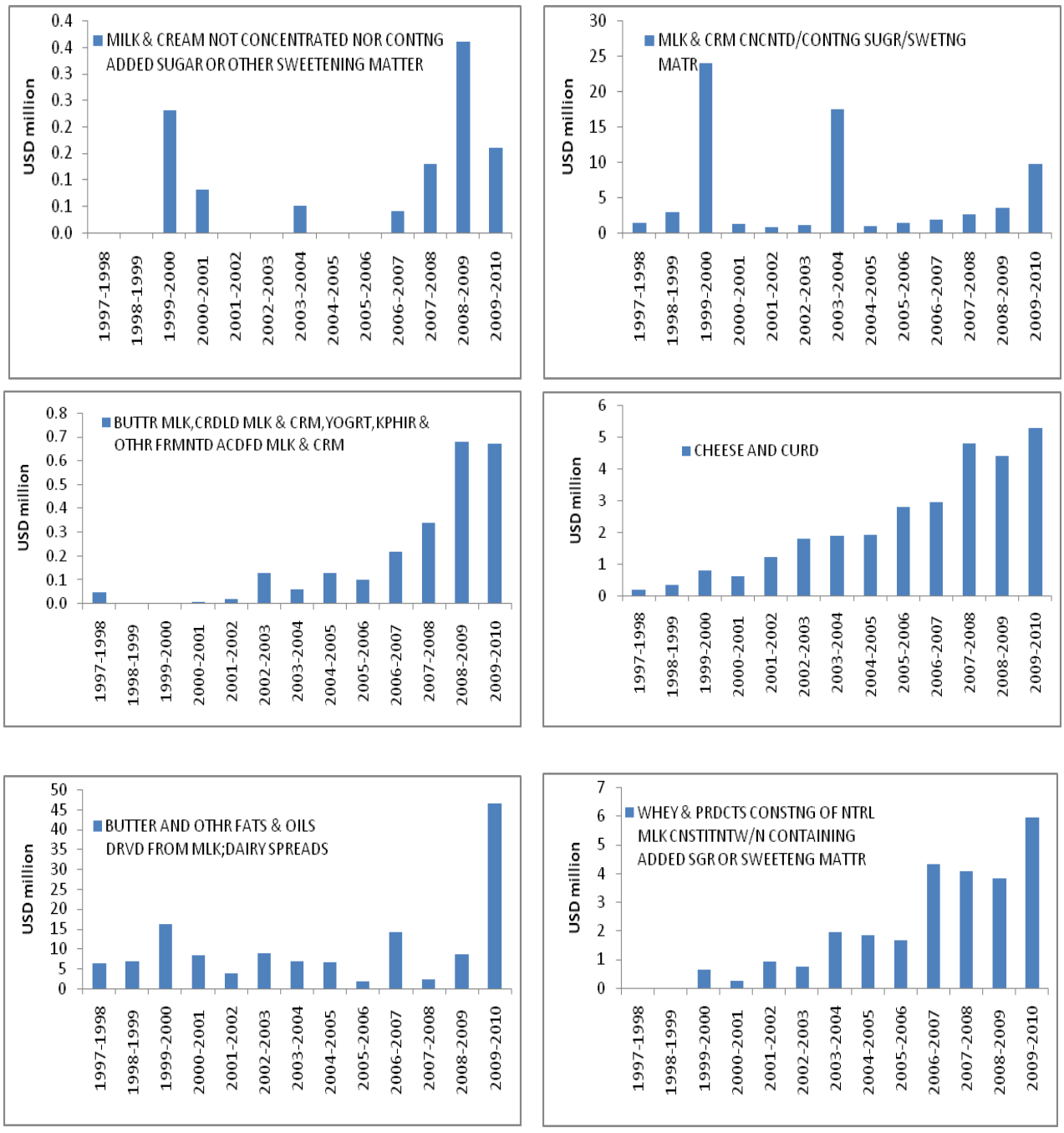
There has been an interest to organize a regional milk grid with the South Asian Association for Regional Cooperation (SAARC) as members since 2000 and some initial progress was made in 2009. SAARC countries include Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka. Afghanistan joined the group in 2005. The objective was to ensure mutual exchange of economic, nutritional and technological gains together with supplying milk to deficit member states at competitive prices. It was proposed that three milk grids be set up in India of which one to be set up in West Bengal (to supply to Nepal, Bangladesh and Bhutan); the second one in Chennai which would export milk to the southwest countries and third grid was proposed to be set up in Gujarat.

Figure 4.26: Export of milk and milk products from India



Source: Ministry of Commerce, Government of India 2011.

Figure 4.27: Import of milk and milk products to India

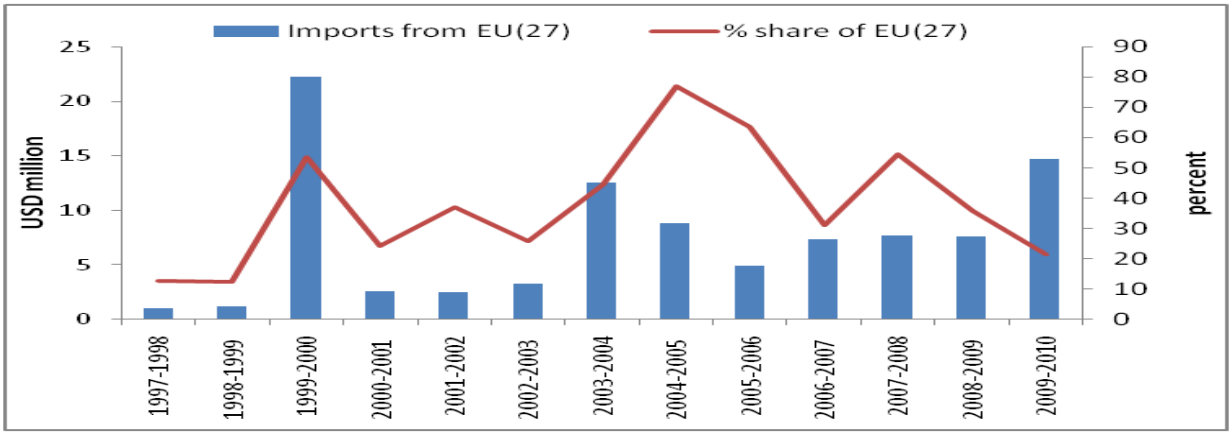


Source: Ministry of Commerce, Government of India 2011.

4.8.4 India- EU (27) Trade in Dairy: Current Status and Future Scope

Although imports of dairy products from EU (27) have been fluctuating, it accounts for a larger share next to Asia and ASEAN region. The value of imports from EU (27) has increased from about a million dollar in 1997-98 to USD 14.7 million in 2009-10. It share in total dairy imports to India has been quite fluctuating, ranging from a low of 12.3 percent in 1998-99 to 76.9 percent in 2004-05 (Figure 4.28).

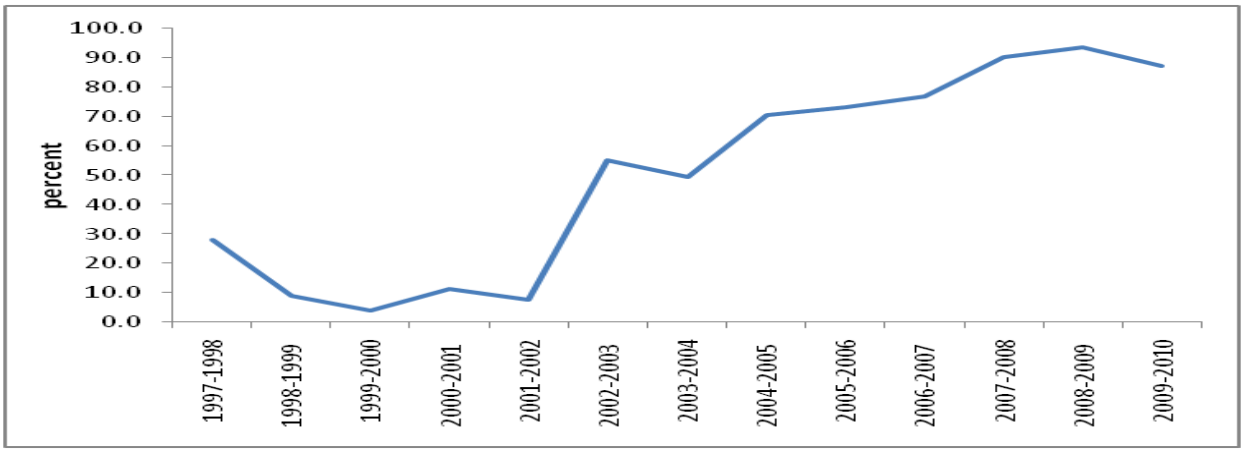
Figure 4.28: Import patterns and trend of dairy products from EU (27) to India



Source: Trade data, Ministry of Commerce, GoI 2011

Import of cheese from this region has picked up over a period of time from less than 10 percent in TE 2000-01 to more than 90 percent in TE 2009-10, although the value of the cheese imported is quite small (Figure 4.8.8). About USD 4.6 million worth of cheese has been imported from EU (27) in 2009-10. The import basket of dairy products from EU (27) comprised of largely milk and cream (concentrated and containing added sugar, etc); nearly 96 percent in TE 1999-2000. The import basket has diversified and contains of cheese (47 percent); milk and cream (concentrated and containing added sugar, etc) (27.7 percent), whey products (18 percent), etc.

Figure 4.29: Rising share of cheese imports from EU (27) in total dairy imports to India



Source: Ministry of Commerce, GoI 2011

4.8.5 Dairy Machinery: Opportunity for Trade and Investments

Despite being the largest producer of liquid milk, processing levels in India are low and this provides and opportunity to scale up activities in this sector. Trade in dairy commodities is subject to availability of excess milk given the rising domestic demand for milk and milk products. There is perhaps greater opportunity for investments in dairy technology, food processing and the like that can contribute effectively toward developing the Indian dairy sector with a focus on processing and marketing of these products. Operation Flood was facilitated by external financial aid that helped create milk chains and link them to the markets. Today there is need for greater in fusion of technology all along the value chain from production to processing and marketing. Opportunities for investment in dairy sector are immense and partnership with foreign investors will be important.

5 Conclusions

Global

The global landscape of dairy is changing in several ways. Dairy consumption is growing faster than population growth. Whereas there is substantial international trade in dairy products, the share of milk production entering world trade is only about 7%. This means that the focus in dairy in production and distribution is often local or regional. World dairy production is expected to grow with about 2% per annum for the coming years till 2020. According to the recent estimates of OECD and FAPRI, production growth is concentrated in the non-OECD area, with New Zealand being an exception.

EU

Dairy production forms an important part of the EU's agricultural economy, with dairying being a widespread activity over Member States as well as regions. In the EU, growth of milk production is currently constrained by the milk quota, which will be in place until 2015, after which they will be abolished. In several Member States the milk quota are now no longer binding. Farm size structure and degree of specialization varies significantly over Member States, with in some of the (new) EU-12 Member States with relatively small farm scales, further restructuring being necessary. Cost of production vary over Member States as well as over time. In the new Member States cost per units show a tendency to increase over time, which is in particular due to the increase in imputed labor costs. For the (old) EU-15 Member States, the average cost of milk production is relatively stable and equal to approximately €350/ton. More than 90% of the milk produced in the EU is delivered for processing. Cooperative as well as private processors are important in milk processing, where their relative importance vary significantly over EU Member States (on average more than 50% of the EU's milk production is processed by farmer-owned cooperatives).

Stimulated by the public support of prices and investments, the EU became a dominant net exporter of dairy products in the 1970's. More recently, its share in the world dairy market has been declining. Partly this is the result of the quota-constrained production of milk, which limits the expansion of production, while the EU's internal demand shows still some growth. As a result the exportable surplus shows a tendency to decline. The recent policy reforms (e.g. 2003 Mid Term Review and 2008 Health Check) have transformed the traditional price support into a safety net arrangement (with relatively low intervention prices for butter and SMP) and increased market orientation in the sector. It is expected that EU milk production will only marginally increase (4%) in the period 2010-2020. However, it is difficult to make a precise assessment about what will happen in the longer run, with quota no longer constraining milk output. There are regions in the EU that have a natural competitive advantage, and might see possibilities to expand. The potential impact of this on EU trade is difficult to estimate, since it also depends on the potential decline in milk output in non-competitive regions in the EU.

India

India's production of milk has strongly increased over time with significant policy support, notably Operation Flood (1970-1996). As regards demand, dairy products fit quite well in the Indian diet and cultural tradition, which is a positive factor contributing to the increased demand for dairy products as a protein source. Annual per capita milk consumption has substantially increased during the past, but is still likely to increase further. In order to have production following the strong increase in demand, a new program is announced for the next decade, which should lead to a milk production of 180 million tons in 2021 (66% increase to current milk production). Although in the past India has been able to achieve high growth rates in milk supply, it has to be seen whether these can be maintained for the future. Up scaling dairy production in a smallholder setting is a real challenge and will require improvements in terms of knowledge, services provided to dairy farmers (extension, veterinary services), and feed availability. If the projected supply would be realized, India could even become a significant exporter of dairy products.

Milk markets in India are still by and large informal, with about two thirds of the marketed surplus sold in informal markets. Organized markets comprising cooperatives and private sector processors share the rest, and almost in an equal proportion. Whereas the informal sector is dominant and has been persistent, because of increasing income (in particular of the middle class), urbanization, increased awareness of issues of food quality and safety, and changing consumer preferences for processed

food, the expansion of modern milk processing and marketing chains is expected to accelerate. In the Indian dairy marketing landscape, Amul and Mother Dairy are special examples of non-private firms active in the dairy market. In particular since the amendment of the Milk and Milk Products order in 2002, the possibilities for private sector companies to enter the dairy market have been increased, with Hatsun Agro Limited and Heritage as notable examples of private businesses of Indian origin. The presence of international players in the Indian dairy processing is limited, with Danone and Nestle being notable exceptions.

The study has revealed that the Indian dairy sector has undergone significant structural changes with time and there are some interesting patterns unfolding all along the milk value chain. Noteworthy among them are the changes in production of milk, composition of livestock population (increase in cross-bred population), marketing of liquid milk pioneered by cooperative networks, increase in participation of private players in the milk processing sector. These changes have contributed significantly to the growth of Indian dairy sector--- popularly known as 'White Revolution'. Though there has been a significant improvement in the milk production and per capita milk availability at the national level, there are several concerns that take away the shine from the glorious achievements in the Indian dairy sector. Despite breakthroughs in milk production and increase in crossbred, high yielding livestock species, productivity of milch animals is quite low in India. This low productivity could be the result of many factors which include: poor genetic make-up of animals, shortage of feed & fodder, inadequate animal health care coverage, inappropriate dairy development policies, lack of market integration between producers and consumers, lack of conducive environment, etc.

Notwithstanding these constraints, India has experienced a significant growth in milk production. The structural changes in the production of milk have been quite visible and the composition of milking animals has tilted in favour of improved crossbred cattle. Further, the role of some new states in augmenting milk production in India is visible. The growth in milk productivity has been considerable and milk productivity growth is reflected in its contribution to output growth. More than half of the growth in milk production during the past two decades has been contributed by the growth in milk yield. The major determinants of milk yield include technological change and quality of herd, development of the crop sector, improving veterinary care and animal health care services, expanding network of dairy cooperatives, and improving human resource capacities of the farmers.

Despite tremendous increase in the milk production, the dominance of traditional marketing channels continues to persist. However, the structure and conduct of milk markets in India has been undergoing a constant change and the role of formal milk marketing chains in expanding within formal sector, the importance of private sector is increasing rapidly.

Milk and milk products emerged as one of the most significant components of food consumption basket of India and the per capita consumption of milk has been steadily increasing.

With increase in income and urbanization, the demand of milk will increase further. The domestic demand of milk would be 209 million tonnes in 2026-27, up from 116.3 million tonnes in 2011-12. The supply projections indicate that with existing growth rate of milk production during the last decade, India would be self-sufficient in milk even in 2026-27. However, any slow down or deceleration would jeopardize the self-sufficiency status of milk production in the country. If concentrated efforts are made to accelerate the growth of milk production, India can turn out to be an important exporter of milk and milk products.

India has the competitive advantage in production of milk. Producer prices of milk are lower in India than in the leading international exporting countries. The price advantage of India vis-a-vis other leading countries enhances its prospects of export of milk particularly to the SAARC countries, most of which are deficient in meeting their domestic requirements..

Achieving a higher growth of dairy sector is essential to ensure long-term inclusive agricultural growth. The productivity-led growth is the only viable option for an accelerated sustainable growth of the Indian dairy sector. The status of supporting infrastructures and their delivery is still wanting and concerted efforts are required to bring the desired improvement. The study has pointed out several avenues and strategies for policy intervention to support dairy development for enhanced milk productivity. The analysis has provided a strong case for a continued investment in improved breeds of cattle and buffalo. The empirical evidence suggested that dairy cooperatives have had impact on growth of dairy sector by facilitating integration between rural producers and urban consumers and also through fostering new technology. The strengthening of market linkages either through expansion

of cooperatives, or facilitating contract farming arrangements would go a long way in ensuring sustainable growth of Indian dairy sector.

The liberalisation of the Indian economy since the early 1990s has also led to a fast response from foreign investors. The introduction of India's New Industrial policy in 1991, and the signing of several bilateral and multilateral investment guarantee agreements with its major trading partners, facilitated a surge in foreign investments into India. This process had also its impact in the dairy sector. As an example in the early 1990s (1991-1994) about 250 milk processing and dairy manufacturing licenses were approved by the Indian government. Multinational firms like Nestle and Unilever expanded their production capacities and widened product offerings (Bhaskaran, 1996).

Trade and investment

As regards trade in dairy products, currently there is only limited trade between the EU and India, where India imports some dairy products from the EU. Exporters from the EU have to face tariff as well as non-tariff measures. EU exporters appear to be sometimes confused due to the frequency with which India adjusts its applied rates to dairy products. As regards the non-tariff measures, the high Indian health standards (veterinary standards) were mentioned as bottlenecks, alongside with customs procedures that create uncertainty regarding paperwork and valuation, and notice and comment procedures that hinder information dissemination about rules affecting imports (see Table 5.1 for an overview).

Export of dairy products to the EU by India are negligible. It turned out not to be easy for India to overcome the EU's relatively high tariff measures for dairy products. Moreover, India would also have difficulty to overcome the EU's non-tariff barriers, although these are roughly in line with internationally accepted standard (see Table 5.1). India's exports mostly go to regional destinations. Since 2003, India has been a net importer of dairy products, but with a degree of self-sufficiency that is close to 100%.

Table 5.1 Trade measures relevant in EU-India dairy trade

Measure	**EU**	**India**	**Comment**
Tariff measures			
Import tariffs	High, and often prohibitive import tariffs	High bound tariffs, lower and varying applied tariffs	India's applied tariffs are frequently adjusted; same holds for EU export restitutions
Tariff rate quota	Are applicable in dairy, but not granted to India	Not relevant	
Non-tariff measures			
sanitary and phytosanitary measures	Generally adheres to internationally accepted health standards (Codex Alimentarius) and veterinary standards, but has higher standard with respect to hormones (BST)	Applies veterinary standards going beyond internationally accepted levels (e.g. OIE guidelines) and which are also higher than domestic ones (e.g. hormones, certain bacteria)	EU and India have similar policy wrt accepting the scientific evidence that the use of hormones (BST) is not harmful)
quality standards	Only accepts imports derived from cow milk obtained via milking machine technology		High standards play a role in acting as a barrier to export bovine semen to India.
labeling and packaging rules	Has specific labeling rules	Has specific labeling rules	Holds more for specific processed foods than for commodity products
monitoring and licencing requirements	Exporting firms have to be certified; EU has not yet certified many Indian firms	For some products a government body introduce license requirements	
state trading enterprises	Not relevant	Not relevant	India has STEs that are involved in trade of food and feedstuffs such as wheat, corn, soya meal, and pulses
customs procedures, notice and comment procedures		Custom procedures are sometimes perceived as barriers to trade due to created uncertainty around paper work	

As has been described in previous chapters of this report, India's demand for dairy products is still growing, where the growth rates tends to outpace the growth in milk supply. Dairy products fit well in the cultural and dietary habits on Indians (particularly with that of the predominant Hindu population), which is reflected in a relatively high positive income elasticity for dairy products (per capita dairy consumption can substantially increase as incomes improve). Moreover there is an increasing segment of consumers (middle class) demanding better quality of products, where international brand franchises could operate as a benchmark for quality goods. Although India's achievements at dairy self-sufficiency have been commendable (e.g. Operation Flood), its potential for a significant expansion of milk output seems limited. India faces constraints in increasing feed and fodder production, shortage of grazing land, and has to cope with inefficiencies in dairy farming methods.

The ongoing deregulation of the Indian economy, has resulted in greater private sector participation in the dairy processing and manufacturing industry. It seems that further reduction of barriers to market entry for products as well as foreign investors would ensue. The cumulative FDI inflows in India since 2000 crossed the 100 billion dollar mark in 2009, with services, housing and real estate, telecommunications, construction, power and automotive being in the top 5 sectors (PWC). As regards dairy, still a relatively low share of the total milk produced in India (<10%) is converted into value added products by the organized sector, whereas it is estimated that this share will have to quickly go up, following the shifting consumer demand. Further promoting food processing industries is an integral part of the Indian government's strategy. Within this context, the India dairy processing and dairy product manufacturing sector is an attractive sector for foreign players to invest in.

With respect to dairy equipment, the small survey among EU companies suggests that FDI is not likely to show a quick growth and create a substitute for direct trade in this field. Respondents indicated that the distance to India is large and the Indian market is not known enough. Besides the distance there have to be enough financial resources. An FDI would earlier be made by large companies than by companies which supply to the small and medium business. Maybe some equipment could be made in a foreign country. A homogenizer for example could be made in India. This machine is not very complicated and it is easy to teach the Indian producers to produce it. The common thought is that the Indian market has to be better explored before FDIs will be made, indicating that enclosing information, can play a helpful role in getting a better utilization of business opportunities.

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Annex A1 Additional data EU

Table A1.1: Milk production, deliveries and dairy herd in the EU, 2009–2020

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Dairy cows (mio heads)	**23.7**	**23.7**	**23.5**	**23.4**	**23.2**	**23.0**	**22.9**	**22.7**	**22.6**	**22.4**	**22.3**	**22.1**
of which EU15	17.9	18.0	17.9	17.8	17.7	17.6	17.6	17.5	17.5	17.4	17.4	17.3
of which EU12	5.8	5.7	5.6	5.6	5.5	5.3	5.3	5.2	5.1	5.0	4.9	4.8
Milk yield (kg/dairy cow)	**6 256**	**6 284**	**6 379**	**6 422**	**6 484**	**6 557**	**6 633**	**6 707**	**6 747**	**6 808**	**6 887**	**6 965**
of which EU15	6 738	6 773	6 865	6 900	6 947	7 007	7 091	7 155	7 170	7 215	7 281	7 347
of which EU12	4 780	4 744	4 837	4 893	4 980	5 069	5 100	5 180	5 283	5 380	5 487	5 591
Milk production (mio t)	**148.5**	**148.6**	**149.9**	**150.0**	**150.4**	**150.7**	**151.7**	**152.1**	**152.4**	**152.6**	**153.3**	**153.9**
of which EU15	120.6	121.6	122.7	122.8	123.2	123.7	124.8	125.4	125.7	125.9	126.4	127.0
of which EU12	27.9	27.1	27.3	27.2	27.2	27.1	26.8	26.7	26.7	26.8	26.8	26.9
Delivered to dairies (mio t)	**133.6**	**133.9**	**135.4**	**135.6**	**136.0**	**136.4**	**137.4**	**137.9**	**138.3**	**138.6**	**139.3**	**140.0**
of which EU15	115.3	116.4	117.6	117.8	118.2	118.6	119.8	120.4	120.7	120.8	121.4	122.0
of which EU12	18.3	17.5	17.8	17.8	17.8	17.8	17.6	17.6	17.7	17.8	17.9	18.0
On-farm use and direct sales (mio t)	**14.9**	**14.7**	**14.6**	**14.5**	**14.4**	**14.3**	**14.3**	**14.2**	**14.1**	**14.0**	**13.9**	**13.9**
of which EU15	5.3	5.2	5.1	5.1	5.1	5.1	5.1	5.0	5.0	5.0	5.0	5.0
of which EU12	9.6	9.5	9.5	9.4	9.4	9.3	9.2	9.1	9.1	9.0	8.9	8.9
Fat content of milk (in %)	**4.03**	**4.04**	**4.04**	**4.04**	**4.04**	**4.04**	**4.04**	**4.03**	**4.03**	**4.03**	**4.03**	**4.03**
Non-fat solid content of milk (in %)	**9.28**	**9.29**	**9.29**	**9.29**	**9.29**	**9.29**	**9.29**	**9.29**	**9.29**	**9.29**	**9.29**	**9.29**

Source: European Commission, 2010

Table A1.2: Cheese market projections for the EU, 2009–2020 ('000 t)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Production	**8 721**	**8 811**	**8 934**	**8 990**	**9 057**	**9 134**	**9 242**	**9 340**	**9 411**	**9 465**	**9 537**	**9 607**
of which EU15	7 583	7 685	7 766	7 797	7 847	7 909	7 993	8 066	8 116	8 150	8 199	8 249
of which EU12	1 138	1 126	1 167	1 193	1 210	1 225	1 250	1 274	1 294	1 315	1 337	1 359
Imports	**84**	**88**	**73**	**84**	**73**	**70**	**75**	**68**	**68**	**74**	**76**	**79**
Exports	**577**	**539**	**594**	**597**	**579**	**580**	**603**	**607**	**596**	**593**	**593**	**599**
Consumption	**8 228**	**8 360**	**8 413**	**8 476**	**8 551**	**8 624**	**8 714**	**8 802**	**8 882**	**8 945**	**9 019**	**9 088**
of which EU15	7 133	7 234	7 267	7 313	7 366	7 418	7 482	7 542	7 600	7 642	7 693	7 739
of which EU12	1 095	1 126	1 146	1 163	1 185	1 206	1 232	1 259	1 282	1 303	1 326	1 349
per capita consumption (kg)	**16.53**	**16.73**	**16.78**	**16.84**	**16.94**	**17.03**	**17.15**	**17.28**	**17.39**	**17.47**	**17.58**	**17.68**
of which EU15	18.09	18.25	18.24	18.28	18.33	18.38	18.47	18.55	18.63	18.67	18.73	18.79
of which EU12	10.60	10.91	11.11	11.28	11.50	11.72	11.98	12.25	12.49	12.71	12.95	13.19

Table A1.3: Butter market projections for the EU, 2009–2020 ('000 t)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Production	**2 083**	**2 016**	**2 057**	**2 054**	**2 053**	**2 049**	**2 073**	**2 075**	**2 064**	**2 065**	**2 071**	**2 088**
of which EU15	1 849	1 803	1 841	1 842	1 840	1 837	1 864	1 867	1 857	1 858	1 864	1 882
of which EU12	234	214	216	213	213	212	210	208	207	207	207	206
Imports	**62**	**38**	**38**	**40**	**38**	**39**	**40**	**40**	**40**	**41**	**40**	**40**
Exports	**148**	**146**	**134**	**113**	**85**	**91**	**107**	**109**	**102**	**98**	**99**	**101**
Consumption	**2 001**	**1 984**	**1 981**	**1 989**	**1 990**	**1 992**	**1 999**	**2 003**	**2 008**	**2 008**	**2 012**	**2 016**
of which EU15	1 803	1 792	1 792	1 799	1 800	1 802	1 809	1 812	1 817	1 817	1 820	1 824
of which EU12	199	192	189	190	190	190	190	190	191	191	191	192
per capita consumption (kg)	**4.02**	**3.97**	**3.95**	**3.95**	**3.94**	**3.93**	**3.94**	**3.93**	**3.93**	**3.92**	**3.92**	**3.92**
of which EU15	4.57	4.52	4.50	4.50	4.48	4.47	4.47	4.46	4.45	4.44	4.43	4.43
of which EU12	1.92	1.86	1.83	1.84	1.84	1.84	1.85	1.85	1.86	1.86	1.87	1.88
Ending Stocks	**115**	**40**	**20**	**12**	**28**	**32**	**40**	**44**	**39**	**38**	**38**	**50**
of which private	38	38	20	12	28	32	40	44	39	38	38	50
of which intervention	77	2	0	0	0	0	0	0	0	0	0	0

Source: European Commission, 2010

Table A1.4: SMP market projections for the EU, 2009–2020 ('000 t)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Production	976	886	860	800	780	767	805	794	778	765	759	756
of which EU15	813	765	745	690	674	667	708	701	691	682	680	680
of which EU12	162	121	115	111	106	100	97	92	87	83	80	76
Imports	6	3	3	3	3	3	3	3	3	3	3	3
Exports	230	273	264	223	199	192	192	190	175	175	177	178
Consumption	647	647	645	640	631	622	625	615	605	594	587	580
of which EU15	571	572	570	565	556	547	550	539	530	519	512	505
of which EU12	75	76	75	75	75	75	75	75	75	75	75	75
Ending Stocks	278	246	199	140	93	49	39	31	32	31	29	31
of which private	20	60	60	61	74	49	39	31	32	31	29	31
of which intervention	258	186	139	79	19	0	0	0	0	0	0	0

Source: European Commission, 2010

Table A1.5: WMP market projections for the EU, 2009–2020 ('000 t)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Production	790	785	781	794	792	792	801	804	803	798	803	796
of which EU15	736	734	730	739	738	738	746	750	748	744	748	741
of which EU12	54	51	51	55	54	54	54	54	55	55	55	54
Imports	1	2	2	1	1	1	1	1	1	1	1	1
Exports	456	451	437	442	440	442	450	451	448	446	452	446
Consumption	335	336	346	353	353	351	353	356	357	355	353	352
of which EU15	299	301	309	316	316	314	316	319	320	318	316	316
of which EU12	36	34	37	37	37	37	37	37	37	37	37	37

Source: European Commission, 2010

Annex A2 Additional data India

Table A2.1: Livestock Population in India (000 numbers)

	1982					1992					2003					2007				
	Cattle					Cattle					Cattle					Cattle				
State	CB	ND	Total	Buffalo	Bovine	CB	ND	Total	Buffalo	Bovine	CB	ND	Total	Buffalo	Bovine	CB	ND	Total	Buffalo	Bovine
Andhra Pradesh	173	13047	13220	8704	21924	486	10460	10946	8845	19791	1107	8193	9300	10630	19930	1898	9325	11223	13272	24495
Arunachal Pradesh	0	168	168	12	180	22	304	326	8	334	13	445	458	11	469	29	474	503	3	506
Assam	145	6605	6750	558	7308	303	7482	7786	652	8438	440	8000	8440	678	9118	410	9631	10041	500	10541
Bihar	151	16062	16213	4641	20854						1274	9455	10729	5743	16472	1976	10583	12559	6690	19249
Gujrat	53	6941	6994	4443	11437	231	6572	6803	5268	12071	639	6785	7424	7140	14564	1142	6834	7976	8774	16750
Haryana	266	2076	2342	3369	5711	416	1717	2134	4373	6506	573	967	1540	6035	7575	566	986	1552	5953	7505
Himachal Pradesh	124	2050	2174	616	2790	280	1885	2165	704	2869	677	1559	2236	774	3010	793	1476	2269	762	3031
Jammu & Kashmir	163	2162	2325	563	2888	792	2262	3055	732	3787	1320	1764	3084	1039	4123	1677	1766	3443	1050	4493
Karnataka	538	10762	11300	3648	14948	627	12548	13175	4251	17426	1602	7937	9539	3991	13530	2193	8310	10503	4327	14830
Madhya Pradesh	66	27051	27117	6435	33552	206	28481	28687	8001	36688	317	18596	18913	7575	26488	475	21440	21915	9129	31044
Maharashtra	492	15670	16162	3972	20134	1769	15672	17441	5447	22888	2776	13527	16303	6145	22448	3122	13062	16184	6073	22257
Orissa	227	12703	12930	1333	14263	744	14022	14766	1949	16715	1063	12840	13903	1394	15297	1703	10607	12310	1190	13500
Punjab	0	3263	3263	4590	7853	1503	805	2309	5764	8073	1531	508	2039	5995	8034	1278	499	1777	5062	6839
Rajasthan	39	13466	13505	6043	19548	69	11513	11582	7743	19325	464	10390	10854	10414	21268	816	11304	12120	11092	23212
Sikkim	33	140	173	4	177	43	140	183	3	186	80	79	159	2	161	73	62	135	0	135
Tamil Nadu	885	9480	10365	3212	13577	1835	7441	9275	3202	12478	5140	4001	9141	1658	10799	7383	3806	11189	2009	13198
Uttar Pradesh	3252	22900	26152	15785	41937	2495	23136	25631	20086	45717	1634	16917	18551	22914	41465	1945	16938	18883	23812	42695
Uttaranchal	0	0	0	0	0	0	0	0	0	0	228	1960	2188	1228	3416	339	1896	2235	1220	3455
West Bengal	554	15104	15658	987	16645	913	16403	17316	986	18302	1119	17794	18913	1086	19999	2642	16546	19188	764	19952
India	8803	183650	192453	69783	262236	14911	161719	176630	78566	255196	24686	160495	185181	97922	283103	33060	166015	199075	105343	304418

Source: BAHS(Different issues)

Note: CB : Cross Breed; Ind : Indigenous

Table A2.2: CAGR of livestock population (% per annum)

State	Cattle CB			Cattle Indigenous			Buffalo			Bovine Population			Cattle Population		
	1982-1992	1992-2003	2003-2007	1982-1992	1992-2003	2003-2007	1982-1992	1992-2003	2003-2007	1982-1992	1992-2003	2003-2007	1982-1992	1992-2003	2003-2007
Andhra Pradesh	10.88	7.77	14.43	-2.19	-2.20	3.29	0.16	1.69	5.71	-1.02	0.06	5.29	-1.87	-1.47	4.81
Assam	7.66	3.44	-1.75	1.25	0.61	4.75	1.57	0.36	-7.33	1.45	0.71	3.69	1.44	0.74	4.44
Bihar			11.60			2.86			3.89			3.97			4.02
Gujrat	15.88	9.68	15.62	-0.54	0.29	0.18	1.72	2.80	5.29	0.54	1.72	3.56	-0.28	0.80	1.81
Haryana	4.58	2.95	-0.31	-1.88	-5.09	0.49	2.64	2.97	-0.34	1.31	1.39	-0.23	-0.93	-2.92	0.19
Himachal Pradesh	8.50	8.34	4.03	-0.84	-1.71	-1.36	1.34	0.87	-0.39	0.28	0.44	0.17	-0.04	0.29	0.37
Jammu & Kashmir	17.13	4.75	6.17	0.46	-2.24	0.03	2.67	3.23	0.26	2.75	0.77	2.17	2.77	0.09	2.79
Karnataka	1.54	8.91	8.17	1.55	-4.08	1.15	1.54	-0.57	2.04	1.55	-2.27	2.32	1.55	-2.89	2.44
Madhya Pradesh	12.06	4.00	10.64	0.52	-3.80	3.62	2.20	-0.50	4.78	0.90	-2.92	4.05	0.56	-3.72	3.75
Maharashtra	13.65	4.18	2.98	0.00	-1.33	-0.87	3.21	1.10	-0.29	1.29	-0.18	-0.21	0.76	-0.61	-0.18
Orissa	12.60	3.30	12.50	0.99	-0.80	-4.66	3.87	-3.00	-3.88	1.60	-0.80	-3.08	1.34	-0.55	-3.00
Punjab		0.17	-4.42	-13.06	-4.10	-0.45	2.30	0.36	-4.14	0.28	-0.04	-3.95	-3.40	-1.12	-3.38
Rajasthan	5.94	18.84	15.16	-1.55	-0.93	2.13	2.51	2.73	1.59	-0.11	0.87	2.21	-1.52	-0.59	2.80
Tamil Nadu	7.56	9.82	9.48	-2.39	-5.48	-1.24	-0.03	-5.81	4.92	-0.84	-1.30	5.14	-1.10	-0.13	5.18
Uttar Pradesh	-2.61	-3.78	4.45	0.10	-2.81	0.03	2.44	1.20	0.97	0.87	-0.88	0.73	-0.20	-2.90	0.44
West Bengal	5.12	1.87	23.96	0.83	0.74	-1.80	-0.01	0.88	-8.42	0.95	0.81	-0.06	1.01	0.81	0.36
India	5.41	4.69	7.58	-1.26	-0.07	0.85	1.19	2.02	1.84	-0.27	0.95	1.83	-0.85	0.43	1.83

Source: BAHS(Different issues)

Table A2.3: Number of livestock per holding

States	1972	1982	1992	1997	2003	2007
Andhra Pradesh	2.31	2.87	2.13	1.91	1.59	1.96
Assam	2.96	3.19	3.34	3.29	3.12	3.79
Bihar	1.97	1.98	2.12	2.15	2.11	1.94
Gujarat	2.66	3.90	3.43	3.45	3.29	3.40
Haryana	2.69	5.65	4.25	4.18	4.71	4.42
Himachal Pradesh	3.57	4.37	3.44	3.39	3.26	3.23
Jammu & Kashmir	2.10	2.79	3.11	2.97	2.74	3.11
Karnataka	2.82	3.47	3.02	2.44	1.83	1.87
Kerala	1.01	0.84	0.71	0.41	0.31	0.25
Madhya Pradesh	4.99	5.23	4.37	3.84	3.28	3.53
Maharashtra	2.97	2.93	2.42	2.27	1.66	1.56
Manipur	3.68	6.51	5.86	4.22	2.82	2.30
Mizoram			3.92	11.73	10.14	9.80
Meghalaya	0.17	0.31	1.10	0.24	0.14	0.15
Nagaland	0.99	1.31	2.57	2.81	2.40	2.72
Orissa	3.37	4.30	4.23	3.83	3.65	3.01
Punjab	2.46	7.70	7.23	8.06	7.61	6.42
Rajasthan	3.34	4.36	3.78	4.09	3.49	3.60
Tamil Nadu	1.99	1.89	1.56	1.47	1.23	
Uttar Pradesh	1.68	2.35	2.28	1.96	2.42	
West Bengal	2.81	2.84	2.91	2.91	2.83	
India	2.53	2.93	2.70	2.50	2.23	2.25

Source: NSSO Report (different issues)

Table A2.4: Number of livestock per hectare

States	1972	1982	1992	1997	2003	2007
Andhra Pradesh	0.92	1.53	1.37	1.41	1.27	1.63
Assam	2.01	2.34	2.63	2.81	2.72	3.42
Bihar	1.30	2.00	2.56	2.85	3.62	4.56
Gujarat	0.65	1.13	1.17	1.32	1.41	1.54
Haryana	0.71	1.60	1.75	1.97	2.03	1.98
Himachal Pradesh	2.34	2.85	2.84	2.92	3.05	3.11
Jammu & Kashmir	2.26	2.81	3.74	3.91	4.11	4.65
Karnataka	0.88	1.27	1.41	1.26	1.06	1.14
Kerala	1.77	1.94	2.14	1.52	1.32	1.09
Madhya Pradesh	1.25	1.53	1.66	1.68	1.61	1.89
Maharashtra	0.69	0.99	1.09	1.21	1.00	1.07
Manipur	3.27	5.53	2.76	3.47	2.45	2.01
Mizoram			2.22	3.63	2.76	3.66
Meghalaya	0.10	0.18	0.80	0.45	0.32	0.27
Nagaland	0.18	0.18	0.38	0.58	0.33	0.39
Orissa	1.78	2.69	3.16	2.95	2.92	2.61
Punjab	0.85	2.02	2.00	2.12	1.89	1.63
Rajasthan	0.61	0.98	0.92	1.03	0.96	1.06
Tamil Nadu	1.37	1.76	1.67	1.61	1.39	
Uttar Pradesh	1.44	2.33	2.54	2.27	2.56	
West Bengal	2.35	3.00	3.24	3.41	3.47	
India	1.10	1.61	1.74	1.77	1.68	1.83

Source: NSSO

Table A2.5: Adoption of crossbreds in India

State	1982		1992		2003		2007	
	% CBT	% CBF	% CBT	% CBF	% CBT	% CBF	% CBT	% CBF
Andhra Pradesh	1.3	1.8	4.4	8.0	11.9	19.3	16.9	26.4
Assam	2.2	2.9	3.9	5.3	5.2	7.2	4.1	5.6
Bihar	0.9	1.2	0.0	0.0	11.9	16.7	15.7	21.0
Gujrat	0.8	0.4	3.4	6.0	8.6	13.0	14.3	20.9
Haryana	11.4	11.8	19.5	23.3	37.2	45.2	36.5	44.1
Himachal Pradesh	5.7	7.3	13.0	18.0	30.3	41.5	35.0	47.0
Jammu & Kashmir	7.0	7.7	25.9	26.1	42.8	47.8	48.7	53.0
Karnataka	4.8	7.0	4.8	7.0	16.8	25.6	20.9	30.6
Madhya Pradesh	0.2	0.3	0.7	1.1	1.7	2.4	2.2	3.2
Maharashtra	3.0	4.6	10.1	16.7	17.0	27.4	19.3	32.2
Orissa	1.8	2.5	5.0	7.5	7.7	10.9	13.8	14.1
Punjab	0.0	0.0	65.1	63.1	75.1	85.2	71.9	79.8
Rajasthan	0.3	0.4	0.6	0.8	4.3	5.4	6.7	8.2
Tamil Nadu	8.5	10.5	19.8	25.0	56.2	63.3	66.0	70.9
Uttar Pradesh	12.4	8.9	9.7	9.6	8.8	11.9	10.4	12.6
West Bengal	3.5	4.9	5.3	7.9	5.9	8.4	13.8	17.1
India	4.6	5.3	8.4	10.1	13.3	19.2	0.0	0.0

Source: BAHS(Different issues)
Note: CBT; CBF;

Table A2.6: Percent share of different state in milk production

State	Milk production (million tonnes)			Share of different state in India (%)		
	1992-93	2001-02	2009-10	1992-93	2001-02	2009-10
Andhra Pradesh	3103	5814	10429	5.35	6.89	9.27
Assam	658	682	756	1.14	0.81	0.67
Bihar	3195	3604	7587	5.51	4.27	6.74
Goa	30	45	59	0.05	0.05	0.05
Gujarat	3795	5862	8844	6.55	6.95	7.86
Haryana	3715	4978	6006	6.41	5.90	5.34
Himachal Pradesh	610	756	836	1.05	0.90	0.74
J & K	937	1360	1604	1.62	1.61	1.43
Karnataka	2590	4797	4822	4.47	5.68	4.28
Kerala	1889	2718	2537	3.26	3.22	2.25
Madhya Pradesh	4879	6078	8123	8.42	7.20	7.22
Maharashtra	4102	6094	7679	7.08	7.22	6.82
Orissa	542	929	1651	0.94	1.10	1.47
Pondicherry	27	37	46	0.05	0.04	0.04
Punjab	5583	7932	9389	9.63	9.40	8.34
Rajasthan	4586	7758	9548	7.91	9.19	8.48
Tamil Nadu	3468	4988	5778	5.98	5.91	5.13
Uttar Pradesh	10649	15714	21580	18.37	18.62	19.18
West Bengal	3023	3515	4300	5.22	4.16	3.82
India	57962	84406	112540	100	100	100

Source: BAHS

Table A2.7: Compound annual growth rate of milk production (% per annum)

State	1992-93 to 1999-00	2000-01 to 2009-10	1992-93 to 2009-10
Andhra Pradesh	6.12	7.01	6.61
Assam	0.43	1.24	0.45
Bihar	1.25	10.86	6.00
Goa	4.79	3.70	4.07
Gujarat	4.74	5.55	4.84
Haryana	3.23	2.04	2.64
Himachal Pradesh	2.57	1.75	2.10
J & K	7.21	1.92	4.11
Karnataka	8.59	-0.04	2.76
Kerala	4.02	-0.79	0.57
Madhya Pradesh	1.83	4.14	3.06
Maharashtra	4.82	3.00	3.48
Orissa	6.09	8.43	7.42
Pondicherry	3.88	3.06	2.59
Punjab	4.63	2.34	3.07
Rajasthan	7.08	3.17	4.55
Tamil Nadu	3.95	2.40	3.14
Uttar Pradesh	4.26	4.16	4.41
West Bengal	1.98	2.47	1.86
All India	4.38	3.83	3.89

Source: BAHS

Table A2.8: Compound annual growth rate of milk production by cows, buffaloes and goats (% per annum)

State	1997-98 to 2003-04						2004-05 to 2009-10					
	Cow			Buffalo	Goat	Total	Cow			Buffalo	Goat	Total
	Crossbred	Non-descript	Total				Crossbred	Non-descript	Total			
Andhra Pradesh	19.17	3.90	9.65	6.92		7.66	12.48	4.66	9.25	7.22		7.75
Assam	2.10	-0.55	0.08	-0.69	0.56	0.00	3.01	-0.53	0.41	1.53	-3.34	0.40
Bihar	-0.49	0.80	0.61	3.00	0.79	2.98	7.87	5.76	6.38	3.54	-2.03	-5.94
Gujarat	7.65	3.74	4.47	4.98	1.67	4.68	26.04	2.39	9.28	4.27	-2.25	5.77
Haryana	12.53	-1.93	4.97	2.62	2.29	3.05	4.30	4.88	4.25	2.46	6.44	2.77
Himachal Pradesh	1.07	4.47	3.18	0.81	-5.74	1.58	6.35	-8.19	0.78	-1.97	-3.53	-0.42
Jammu & Kashmir						3.16						2.95
Karnataka	6.03	-3.77	0.71	-0.31	11.98	0.44	7.40	1.96	5.15	2.10	7.71	4.17
Kerala	0.75	-10.76	-0.36	-9.66	-5.86	-0.86	4.70	5.15	4.74	1.81	11.09	4.96
Madhya Pradesh	-0.51	3.30	2.97	2.83	1.08	2.78	18.69	3.59	5.14	4.41	0.73	4.47
Maharashtra	4.76	2.69	3.94	2.49	3.58	3.25	4.77	2.13	3.99	2.59	-0.14	3.21
Orissa	11.13	0.90	6.16	8.15	1.46	6.53	6.80	5.69	6.26	1.98	-4.53	5.61
Punjab	2.23	-10.79	1.13	3.15	-4.77	2.54	5.99	24.09	7.10	-0.25	2.91	1.83
Rajasthan	18.01	0.05	0.73	4.81	4.12	3.45	12.61	1.50	2.65	2.91	2.61	2.80
Tamil Nadu	7.28	2.66	5.33	-2.28		2.58	11.08	-6.77	6.28	-8.63		3.06
Uttar Pradesh	10.93	3.39	5.49	4.60	4.02	4.81	2.78	2.99	2.92	4.51	2.90	3.98
West Bengal	0.77	0.81	0.80	-1.75	65.81	1.20	11.56	-1.58	3.21	-6.10	0.76	2.52
India	5.42	1.50	3.12	3.62	3.18	3.42	8.39	2.41	5.34	3.37	2.00	3.95

Source: BAHS (Different issues)

Table A2.9: Percent share of milk production by cows, buffalo and goats statewise

State	1993-94					2000-01					2009-10				
	Cow			Buffalo	Goat	Cow			Buffalo	Goat	Cow			Buffalo	Goat
	Crossbred	Non-descript	Total			Crossbred	Non-descript	Total			Crossbred	Non-descript	Total		
Andhra Pradesh	5.82	23.00	28.81	71.19	0.00	10.58	17.64	28.22	71.78	0.00	17.25	9.87	27.12	72.88	0.00
Assam	17.01	65.98	82.99	13.46	3.55	21.08	62.37	83.46	13.03	3.51	24.47	59.66	84.13	12.96	2.91
Bihar	5.01	35.99	41.00	47.15	11.85	2.91	19.15	22.07	42.95	8.21	33.31	74.38	107.69	95.57	8.22
Gujarat	6.00	26.43	32.43	63.07	4.50	4.86	27.01	31.87	63.86	4.27	16.00	21.62	37.62	59.76	2.61
Haryana	4.44	13.27	17.71	80.26	2.03	10.27	8.95	19.22	78.68	2.10	9.14	6.26	15.40	83.58	1.02
Himachal Pradesh	18.35	26.45	44.80	51.22	3.98	17.35	28.65	45.99	49.54	4.47	43.42	17.94	61.36	35.89	2.75
Jamm & Kashmir	39.74	26.28	66.03	29.36	4.62	49.74	21.73	71.46	22.86	5.68	0.00	0.00	0.00	0.00	0.00
Karnataka	17.69	35.71	53.40	46.13	0.48	24.57	33.62	58.19	40.90	0.91	42.31	25.36	67.67	31.23	1.10
Kerala	73.06	15.94	89.01	5.50	5.50	85.41	7.49	92.90	2.42	4.68	88.06	5.20	93.30	1.73	4.97
Madhya Pradesh	3.38	38.09	41.47	51.06	7.48	4.01	38.30	42.31	50.81	6.88	6.41	37.70	44.12	50.19	5.70
Maharashtra	25.58	24.14	49.72	45.53	4.75	29.15	19.03	48.18	47.08	4.74	37.60	15.04	52.64	43.69	3.67
Orissa	30.97	49.20	80.18	19.47	0.35	44.29	35.73	80.02	19.75	0.23	43.49	42.82	86.31	13.51	0.18
Punjab	23.23	4.09	27.32	71.94	0.74	23.45	2.52	25.97	73.47	0.55	29.28	2.91	32.19	67.34	0.47
Rajasthan	0.00	37.01	37.01	52.20	10.79	1.02	31.09	32.11	57.79	10.10	3.99	24.30	28.29	61.16	10.55
Tamil Nadu	23.24	36.41	59.65	40.35	0.00	36.90	26.19	63.10	36.90	0.00	73.17	13.66	86.83	13.17	0.00
Uttar Pradesh	5.87	21.86	27.73	66.39	5.88	7.38	20.05	27.44	66.60	5.97	8.69	17.96	26.65	67.98	5.37
West Bengal	27.04	64.30	91.34	8.37	0.29	28.49	61.77	90.26	9.39	0.35	42.64	49.22	91.86	5.00	3.14
India	14.17	27.66	41.85	53.67	4.39	17.53	23.36	40.89	53.88	4.05	22.53	19.96	42.49	52.60	3.47

Source: BAHS (Different issues)

Table A2.10: Compound annual growth rate of milk yield (% per annum)

State	1992-93 to 1999-00					2000-01 to 2009-10					1992-93 to 2009-10				
	Cattle			Buffalo	All	Cattle			Buffalo	All	Cattle			Buffalo	All
	Crossbred	Non-descript	Total			Crossbred	Non-descript	Total			Crossbred	Non-descript	Total		
Andhra Pradesh	-1.01	6.21	7.79	4.73	5.70	1.49	13.17	3.75	2.63	3.03	1.05	10.56	5.22	3.74	4.13
Assam	-1.14	-0.58	0.28	-0.84	0.18	-0.41	0.14	0.38	2.24	0.56	-1.24	-0.13	0.28	-0.20	0.25
Bihar	1.82	1.91	4.30	0.20	1.27	0.14	0.02	0.44	1.24	0.52	1.78	2.00	2.68	1.01	1.27
Gujarat	0.52	1.37	1.32	1.13	1.20	1.04	2.27	4.25	1.81	2.67	0.46	1.70	2.48	1.15	1.63
Haryana	0.83	1.42	2.75	1.42	1.72	0.10	1.91	1.22	1.32	1.37	0.21	1.53	1.91	1.16	1.34
Himachal Pradesh	-0.85	2.38	2.46	0.19	1.43	1.97	-2.59	2.41	-1.48	0.46	0.76	1.01	2.59	-0.46	1.08
Karnataka	2.59	5.81	6.86	1.94	4.76	-0.66	0.36	2.07	-2.70	0.33	0.22	2.09	3.57	0.29	2.31
Kerala	3.00	5.28	5.66	8.66	5.82	2.99	0.77	3.07	-0.07	3.01	2.74	2.32	4.04	3.34	4.06
Maharashtra	0.66	3.75	5.05	2.53	4.11	-0.95	0.23	2.40	0.45	1.49	-0.35	0.70	2.33	0.73	1.62
Madhya Pradesh	-0.45	1.73	1.89	0.02	1.89	0.79	1.90	2.46	1.15	1.87	0.39	3.19	3.28	1.10	2.74
Orissa	5.64	2.10	5.60	5.98	5.62	1.67	12.05	8.77	1.60	7.55	4.07	6.23	7.09	4.55	6.64
Punjab	1.85	-1.67	2.08	1.61	1.77	2.08	7.58	3.04	3.22	3.26	1.12	1.96	2.05	2.17	2.16
Rajasthan	0.39	0.07	0.30	0.88	0.92	4.05	3.49	4.18	3.79	4.14	2.59	1.46	1.90	1.97	2.20
Tamil Nadu	3.37	1.08	4.03	2.19	3.33	0.49	0.63	4.09	0.44	3.49	1.53	1.12	3.75	1.46	3.21
Uttar Pradesh	3.01	1.80	2.65	1.70	2.10	1.00	1.09	1.32	0.76	1.06	1.96	1.62	2.29	1.39	1.76
West Bengal	5.42	2.46	3.39	5.23	3.57	-0.98	-0.37	1.07	-1.97	0.72	-0.45	0.17	0.79	0.13	0.67
All India	2.38	2.24	3.54	1.87	2.83	0.50	1.49	2.58	1.39	1.93	0.92	1.49	2.56	1.58	2.10

Source: BAHS (different issues)

Table A2.11: Milk yield (Kg/day)

State	1992-93					2000-01					2009-10				
	Cattle			Buffalo	All	Cattle			Buffalo	All	Cattle			Buffalo	All
	Cross-bred	Non-descript	Total			Cross-bred	Non-descript	Total			Cross-bred	Non-descript	Total		
Andhra Pradesh	6.62	1.20	1.34	2.22	1.87	6.34	1.72	2.36	3.20	2.91	7.19	1.83	3.48	3.94	3.80
Assam	3.77	0.98	1.09	1.89	1.16	3.51	0.99	1.21	1.82	1.27	3.31	0.95	1.20	2.05	1.27
Bihar	4.92	1.63	1.79	3.35	2.58	6.10	2.80	3.39	3.62	3.50	6.10	2.41	2.97	4.13	3.42
Gujarat	7.47	2.75	3.07	3.70	3.47	7.35	3.01	3.31	3.89	3.67	8.45	3.68	4.84	4.51	4.63
Haryana	6.33	3.84	4.25	5.28	5.06	6.71	4.27	5.30	5.89	5.76	7.31	4.68	5.94	6.67	6.54
Himachal Pradesh	3.84	1.56	1.79	3.31	2.39	3.78	1.90	2.35	3.18	2.71	4.39	1.52	2.83	3.33	2.99
Karnataka	5.47	1.50	1.94	2.34	2.11	6.47	2.24	3.10	2.99	3.05	5.95	2.24	3.67	2.55	3.22
Kerala	5.37	1.86	3.92	3.57	3.89	6.56	2.51	5.80	5.79	5.80	8.58	2.68	7.64	5.86	7.59
Madhya Pradesh	5.93	1.19	1.27	3.00	1.70	5.72	1.47	1.56	3.06	2.19	6.29	1.86	2.08	3.53	2.69
Maharashtra	6.66	1.23	2.11	3.14	2.50	7.10	1.61	3.03	3.75	3.34	6.51	1.61	3.48	3.81	3.62
Orissa	3.06	0.45	0.66	1.43	0.73	4.81	0.51	1.01	2.48	1.14	5.94	1.17	1.97	2.90	2.06
Punjab	7.40	3.27	6.21	5.70	5.83	8.58	3.12	7.33	6.64	6.81	10.54	5.64	9.78	8.51	8.88
Rajasthan		2.76	2.76	3.91	3.34	5.33	2.78	2.83	4.12	3.54	7.91	3.68	3.98	5.66	4.99
Tamil Nadu	4.82	2.34	2.93	3.31	3.07	6.00	2.68	3.98	4.07	4.01	6.39	2.78	5.30	4.25	5.13
Uttar Pradesh	5.16	1.93	2.20	3.54	3.00	6.36	2.24	2.72	4.05	3.54	6.98	2.47	3.13	4.38	3.93
West Bengal	4.98	1.84	2.15	4.22	2.24	6.67	2.06	2.63	5.90	2.78	5.98	1.83	2.70	4.59	2.76
All India	5.57	1.65	2.12	3.46	2.71	6.44	1.92	2.75	4.05	3.36	6.87	2.14	3.37	4.57	3.94

Source: BAHS (Different issues)