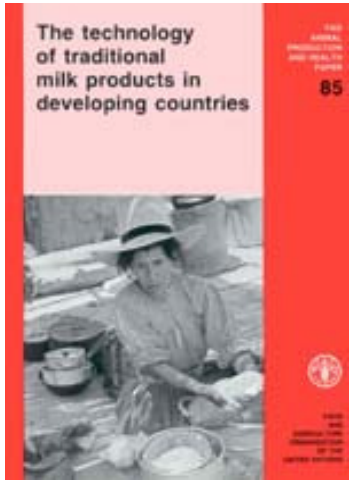

FAO ANIMAL PRODUCTION AND HEALTH PAPER 85

The technology of traditional milk products in developing countries

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FOREWORD

This publication attempts to bring together recent information and the technology of traditional milk products in developing countries.

It is based on two sources of information:

i. **Contributions by 6 authors from the different regions of developing countries.**

ii. **Responses to questionnaires circulated by FAO to one hundred countries in 1987 and 1988.**

The following authors prepared manuscripts relating to the technology of traditional products in their respective regions:

- **Aneja, R.P. - India and neighbouring countries**
- **Bekele, E. - Ethiopia and Mali**
- **Brito, C. - Southcone countries of Latin America**
- **Kronflleh, A.R. and Laban, L. - Middle East - Syria**
- **Kurwijila, L.R. - Southern and Eastern Africa**
- **Nembang, L.B. - Nepal and Bhutan**

Their contributions were collated by R.J.M. Crawford (Scotland), edited by staff members of the Meat and Dairy Service of FAO and constitute Part A.

The replies to the questionnaires were edited and grouped as set out in Part B of this publication by P. Coppé, APO, Meat and Dairy Service of FAO. It must be stressed that the replies to the questionnaires were not always complete and that it was not possible for FAO to check the accuracy of certain details. This section must, therefore, be viewed as a first attempt to provide up-to-date information on the technology of a comprehensive range of traditional

dairy products in developing countries. Future studies will refine these data and FAO would welcome contributions from readers on specific products or groups of products to assist in making the data as comprehensive and accurate as possible.

SUMMARY

Milk as a raw material. Traditional milk products are prepared from milk from several species:- indigenous cattle and exotic dairy breeds, buffalo, sheep, goats, yaks and camel. The role of the individual species varies dramatically from region to region and within countries of the same region.

The composition of milk of different species has important influences on the yield of traditional milk products e.g. high fat-producing species are of major importance in countries where ghee is an important product.

The availability of milk for the preparation of traditional milk products depends not only on the total amount of milk produced in a country but also on how much of the milk is dispatched to industrial dairy factories and how much is retained by the milk producer for the direct use of the household, or for the preparation of milk products for local sale, or for use in calf rearing.

Countries with proportionally the highest quantities of milk being used for preparation of traditional milk products on the producer's farm or household, or local small processing units tend to have the less well developed dairy industry. It should be recognised that factors such as the standard of road and rail links between the milk-producing areas and the urban areas is of importance in determining how milk is utilised. Animal breeding and feeding pose major problems to the small milk producer where traditional milk products are important and technical support services are commonly absent or insufficient.

Milking conditions and hygiene. The general standard of hygiene applied to milk production in developing countries is poor and as a result the quality of milk is poor.

Thorough cleaning and disinfection of the utensils used for milk and milk processing are essential for the production of good quality milk but few of the small milk producers can practice modern methods of cleansing. The practice of smoking milk vessels is common in eastern Africa and appears to have value in disinfecting the utensils as well as contributing a smoky flavour to milk products.

Hand milking is the almost universal practice in the countries reviewed.

Some countries have introduced payment schemes intended to reward the producer who supplies milk of good hygienic quality, but in general, farmers have insufficient knowledge of, and skill in clean milk production.

It must be recognised that many of the small farmers produce milk under exceedingly difficult climatic conditions.

Of major concern is the lack of veterinary control of milk-producing animals in many countries which when linked with the direct use of raw milk for milk products results in conditions which may cause milk-borne disease and food poisoning or at least damage the reputation of traditional milk products.

Prevention, or limitation of the spoilage of milk is based on boiling, or on souring, simple condensing with sugar addition or immediate processing into traditional milk products.

Level of processing. Preparation of traditional milk products is a household operation in many of the developing dairy industries. In southern and eastern Africa there is no record to show

that milk processing has ever been organised at the community level as is the case with the processing of cereals.

Producer cooperatives are being formed in Africa and elsewhere. Dairy cooperatives in India perform the procurement of milk of suitable quality in a condition fit for processing. Milk is mostly produced in small quantities of two to four litres by small and marginal farmers in innumerable and widely scattered villages.

The proportion of milk retained on individual farms in the southcone countries of Latin America ranges from ten per cent in the case of Argentina - a dairy exporting country applying modern technology in its industrial dairy sector - to eighty per cent in the case of Paraguay. Small-scale manufacture of traditional products is of little importance in Argentina whereas in Paraguay much of the individual's supply of milk products is derived from traditional milk products made in small units. Projects are being undertaken in several countries to improve small-scale manufacture of traditional milk products but much more must be done worldwide to strengthen the role of this important sector of the agricultural industry. Traditional milk products produced on a small scale are in most cases capable of being adapted to medium and large-scale methods.

Technologies of the main categories of traditional milk products. Information is provided on traditional milk products under four categories:- fermented milks, butter and ghee, cheeses, and other milk-based products. Fermentation of milk to control the growth of spoilage bacteria and some forms of pathogens is the most common aspect of technology in the preparation of traditional milk products. The use of natural controlled fermentation is seen in the preparation of products such as dahi in the Indian sub-continent, laban in Syria, irgo in Ethiopia and other soured milk in southern and eastern Africa. These soured milks, as well as being liquid milk products in their own right, are the basis for the production of unsalted butter, ghee (or

butteroil) and curd cheese in the household, the local village processing unit or the industrial scale dairy factory. Much of Africa has no tradition of cheesemaking based on coagulation of casein. In the Indian sub-continent, organic acids are used to precipitate milk proteins in the formation of the base material for sweets. In the southcone countries of Latin America cheesemaking is an important sector of the dairy industry and traditional cheese types based on rennet coagulation of milk, and in most cases bearing a similarity to European varieties, are made on a small-scale in farms and by modern methods in dairy factories.

The use of heat to concentrate and preserve milk is practised widely and is the basis of a wide range of traditional milk products, particularly in the Indian sub-continent and Latin America.

Economic importance of traditional milk products. Livestock farming in general and milk and milk products in particular play an important socio-economic role in all of the countries reviewed. The extent of dependence of the farmer on traditional milk products varies from country to country and within countries. Climate, development of roads and transport within a country, and the level of industrial milk processing are some of the factors in determining how important these products are.

In addition to the actual value of the product to the farmer, the country and the region, the importance of work in small-scale milk processing in rural areas is stressed.

The agricultural industry is economically very important for all of the countries reviewed and recommendations are made for policies which will develop traditional dairy products in value and quality.

Nutritional importance of traditional milk products in the national diet. The importance of traditional milk products in the diet is related to the overall availability of milk to the population

of each country, and within a country to the consumption of milk and milk products in rural and urban areas.

In many countries milk consumption is well below the requirement for a balanced diet as recommended by FAO.

Since much of the preparation of traditional milk products takes place in rural areas - many of them isolated by lack of transport - their importance from a nutritional point of view is greater for the local population than for that of the urban areas.

Nevertheless, traditional milk products such as butter and ghee and milk protein-based foods contribute much of the dietary requirements of national populations. Contributions examine the role of traditional milk products in a country or regional context.

Organization of marketing. Traditional milk products reach the consumer through many different marketing channels. In southern and eastern Africa only a small fraction of the milk is marketed by commercial enterprises and nearly all traditionally prepared milk products are marketed through informal marketing channels. In many cases there is no middleman between the producer and the consumer. Variations from this simple procedure to sales to intermediaries of dairy cooperatives and supermarkets exist in many countries. Marketing may also be undertaken by government agencies. The state of marketing and sales is discussed in relation to the future development of traditional milk products from several viewpoints including the improvement in quality.

General discussion, summary and conclusions. There is general accord that traditional milk products are of great importance to all of the countries and regions surveyed. Not only when the products are prepared and sold by empirical methods in a rural, semi-urban or urban

location but also where the scale and technology of production has moved on to the industrial dairy sector and associated marketing and distribution practices apply.

The characteristics and the technology which are described suggest that in developing countries traditional milk products are made in general under primitive conditions which result in low yields and also in poor quality products. Suggestions for the development of traditional milk products start with the need for improved veterinary control of cattle to ensure a safe milk supply; programmes for improved hygiene practices for milk production; establishment of village-based milk processing units; improvements in processing equipment to achieve better efficiency and product quality; training of milk producers and milk processors to develop their knowledge and skills; technical support for this sector of livestock farming.

Many contributions stress the need for national and international policies which take account of the value and importance of the traditional milk product sector of the dairy industry and recommend that this sector should be taken account of in future policies as appropriate.

Part A

IMPORTANCE, TECHNOLOGY AND ECONOMICS OF TRADITIONAL MILK PRODUCTS

I MILK AS A RAW MATERIAL ANIMAL SPECIES AND MILK COMPOSITION>

The preparation of traditional milk products in the regions and countries covered by reports from several contributors and respondents to the FAO world survey is influenced by many

factors including agricultural practices, animal husbandry, periods of availability of milk as influenced by weather, climate, stage of development of commercial milk processing in individual countries, eating habits of the rural and urban populations etc. and facilities for conservation of milk etc.

Of very considerable influence is the species of animal used for milk production and other agricultural purposes, the breeds of the different species used for milk production and the composition and suitability of the milk of different species for the preparation of milk products.

The composition of milk from different species is given in Table 1.

The general importance of the individual species for milk production in various regions is summarised in Table 2.

Table 1. Composition of the milk of different species

	Fat	Protein	Lactose	Ash	Total solids
	(percentage w/w)				
Cow					
Indian subcontinent(8)	4.6	3.3	4.9	0.67	13.47
Borana (1)	5.40	3.30	4.90	0.80	14.54
East African Zebu (2)	5.50	3.30	4.70	0.76	14.30
Jersey(2)	5.20	4.00	4.80	0.75	14.50
Holstein-USA(3)	3.41	3.30	4.87	0.68	12.28
Sheep					
General(4)	5–8	5–6.5	3.9–4.4		16–20
Merino-mazech(7)	6.61	5.39	4.13	0.94	17.2

crossbred					
Merino-balbaas(7)	6.01	5.26	4.53	0.97	16.84
crossbred					
Balbaas breed(7)	5.84	5.28	4.69	0.96	16.86
Goat					
General(4)	3.5–8.0	2.8–3.0	3.9–4.4		11.5–13.5
General(5)	4.2	3.5	4.8	0.79	12.9
British alpine(5)	3.4		4.4	0.78	11.5
Anglo-nubian(5)	4.1		4.2		12.2
Norwegian(6)	3.54				11.37
Saanen x					
Tanzanian(6)	6.95				16.20
Buffalo					
Indian sub-					
continent(8)	6.6	3.9	5.2	0.8	15.8
Yak and yak					
crosses	7–9				17–18
Nepal and					
Bhutan(9)	7–9				17–18
					(solids-non- fat about 11)
Source:-					
(1–7 below cited by Kurwijila (1989)					

1 Nicholson (1983)

2 Musangi (1971)

3 Webb, Johnson and Alford (1974)

4 Gall ((1975)

5 Devendra (1975)

6 Kurwijila (1988b)

7 IDF (1969)

8 Aneja (1989)

9 Nembang (1989)

Table 2. General importance of milk-producing species in various regions and countries

Region and Country	Except where stated, the figures are percentages (to the nearest whole figure) of the total milk production of the country, produced by individual species.					
	Cow	Sheep	Goat	Buffalo	Camel	Yak
Africa - southern and eastern	69	11	15	Used in some countries in the region	A source of milk in arid and semiarid areas. There are no camels in countries south of Kenya	
Botswana[1]	97		3			
Burundi[1]	73	3	21			

Ethiopia[1]	72	8	12		Provides milk for the Gabbra of southern Ethiopia	
Kenya[1]	89	3	7		Important source of milk for the Turkana	
Lesotho[1]	100					
Madagascar[1]	100					
Malawi[1]	100					
Mozambique[1]	89		12			
Rwanda[1]	84	1	15			
Somalia[1]	27	18	54			
Sudan[1]	59	23	18		Provides milk for desert Bedouins	
Swaziland[1]	100					
Tanzania[1]	87		13	Several hundred buffalo are kept on one research station		
Uganda[1]	100					
Zambia[1]	100					

Zimbabwe[1]	100					
West Africa - Mali[2]	61	18	21			
Southcone[3] Countries of Latin America	Nearly all the milk produced which is commerialised		of importance in some areas			
Middle East-Syria[4]	48	45	7	Introduced in 1985		
Indian sub-continent[5]	Important producer of milk	Used for milk production in some parts of the region	Used for milk production in some parts of the region	Important producer of of milk	Used for milk production in some parts of the region	Used for milk production in some parts of the region
India[5]	33		3	64		
Nepal and Bhutan[6]	Important milk animal in the mid- hills and terai			Use for milk production in the midhills and terai		Important milk animal in the Alpine areas

Source:-

1. Kurwijila (1989)

2. Bekele (1989)

3. Brito (1989)

4. Korenfaleh and Labban (1989)

5. Aneja (1989)

6. Nembang (1989)

Table 3. Estimated milk production in countries of southern and eastern Africa in 1985 (FAO, 1987)

Country	Cow	Sheep	Goat	Total	Population	*per capita*
	(thousand metric tons)				('000)	supply (kg)
Botswana	96	-	3	99	886	111.7
Burundi	24	1	7	33	4577	7.2
Ethiopia	595	63	95	822	33765	24.3
Kenya	1000	28	79	1128	18612	60.6
Lesotho	22	-	-	22	1444	15.2
Madagascar	41	-	-	41	9492	4.2
Malawi	39	-	-	40	6813	5.9
Mozambique	65	-	9	73	11359	6.4
Rwanda	72	1	13	86	5276	16.3
Somalia	144	97	287	738	5301	139.2
Sudan	1700	590	530	2870	20020	143.4
Swaziland	38	-	-	38	609	62.4

Tanzania	424	-	62	486	19736	24.6
Uganda	364	-	-	364	14511	25.1
Zambia	73	-	-	73	6374	11.5
Zimbabwe	195	-	-	195	8209	23.8
Total	4892	780	1085	7108	166984	

Source: FAO, Rome (1987)

*** FAO, Production Yearbook, 1983**

**** Calculated**

Source: Kurwijila (1989)

1. SOUTHERN AND EASTERN AFRICA - GENERAL.

MILK SUPPLY. According to FAO (1987) estimates, sixteen countries in southern and eastern Africa listed in Table 3 produced about 7 million metric tons of milk in 1985. Of the total milk produced, about 69 per cent was cow milk while sheep and goats produced respectively 11 per cent and 15 per cent of the total. The remaining 5 per cent difference which was not given in the FAO estimates of the contribution of individual animal species was presumably milk produced from a few herds of water buffaloes and camels. The 1983 FAO human population estimates have been included in Table 3 so as to provide a clue as to the per capita supply of total milk and specific animal species milk in the individual countries and the sub-region as a whole.

There is no doubt that cow milk is the most important in the sub-region even though the per

capita goat milk production of 54 and 27 kg/annum for Somalia and Sudan respectively imply that such milk plays an important role in the diet of specific communities in the two countries. Sheep milk is also produced in considerable amounts in Sudan (29.5 kg per capita) and Somalia (20.5 kg per capita). Goat milk plays a less significant role in Kenya (4.2 kg per capita), Botswana (3.4 kg per capita), Tanzania (3.1 kg per capita), Ethiopia (2.8 kg per capita) and Mozambique (0.8 kg per capita). Apart from Sudan and Somali, sheep milk appears to play some role in Ethiopia (1.9 kg per capita) and Kenya (1.5 kg per capita) but not in the rest of the countries of the sub-region.

The per capita milk supply reviewed above may not mean much when translated into actual milk consumption by individuals in the respective countries. Whereas cow milk is universally accepted wherever cattle are raised, the usage of milk from sheep, goat, camel and other less well known milch animals varies from one community to another within the same country, region or even district depending on cultural habits and preferences. Studies done at the International Livestock Centre for Africa (ILCA) in Addis Ababa, Ethiopia, have revealed that the Borana pastoralists seldom drink sheep milk whereas goat milk is often used as a dry season reserve, particularly for children. In Kenya, the Turkana people take milk from both sheep and goat while the Maasai, Samburu and Kenya Borana use only goat milk (Nicholson, 1984). Non-pastoral tribes rarely consume goat or sheep milk except for medicinal purposes.

In the arid and semi-arid areas of Africa, the camel is an important source of milk for the Gabbra of Southern Ethiopia, the Turkana in Kenya and desert Bedouins (Nicholson, 1984). There are no camels in countries South of Kenya. In Tanzania several hundred buffaloes are kept on one research station and the acceptability of buffalo milk has not been reported to be a problem.

The estimates of the milk available for traditional milk processing and marketing in countries of

southern and eastern Africa in 1985 are given in Table 4.

Table 4. Estimated milk available for traditional milk processing and marketing in countries of southern and eastern Africa (1985) (thousand metric tons)

Country	Total cow milk	Traditionally processed milk (estimate)	Milk Converted to butter + buttermilk	Commercially processed milk
Botswana	96	77	38.5	-
Burundi	24	19	9.5	0.671 (1982)[1]
Ethiopia	595	476	233	-
Kenya	1000	400	200	595 (1985)[2]
Lesotho	22	18	9	-
Madagascar	41	33	16.5	-
Malawi	39	31	15.5	3.454(1979)[3]
Mozambique	65	52	26	-
Rwanda	72	58	29	-
Somalia	144	115	57.5	-
Sudan	1700	1360	680	-
Swaziland	38	30	15	2.675 (1982)[4]
Tanzania	424	339	169.5	5.4 (1987)
Uganda	364	291	145.5	-
Zambia	73	58	29.0	12.8 (1976)[6]
Zimbabwe	195*	128	64	**202 (1986)[7]
Total	4892	3485	1792.5	

Total	1982	8488	1782.8	

Source: Compiled by Kurwijila (1989)

1 Kakunze, (1984)

2 Abate et al (1984)

3 Kumwenda (1984)

4 Mavuso and Dlamini (1984)

5 Lohay (1988)

6 Kaluba (1984)

*** A figure of 195 million litres for Zimbabwe (FAO, 1985) appearsto be an underestimate by at least 50% *vis a vis a* cattle populationof 5 million (Mupunga, 1987) which should product about 160 millionlitres of milk if one assumes that 20% are in milk each year andproduce 160 1 per lactation.**

**** The 202 million litres handled commercially by the Zimbabwe DairyMarketing Board came largely from the 100,000 head of dairy cattle(Mupunga, 1987, Rodriquez, 1987).**

MILK COMPOSITION. Information on the milk composition of indigenous stock, particularly of sheep and goats is very scanty if not lacking. Table 1 gives the gross milk composition of Ethiopian Borana cattle (Nicholson, 1983) and some generalised data on the east African Zebu (Musangi, 1971), sheep and goats (Gall, 1975). In each case, the composition of milk of temperate breeds of cattle, sheep or goats has been included to give a comparison of chemical

quality.

Generally, indigenous stock produce small quantities of milk which is more highly concentrated in terms of total solids and butterfat than milk produced by dairy breeds of temperate countries.

BACTERIOLOGICAL QUALITY. Due to the rather simple conditions under which milking takes place (see section 3), it would be expected that milk produced in developing countries would have very high initial bacterial contamination. However, due to the minimal use of equipment and the practice of milking directly into the milk storage vessels, milk produced under traditional systems tends to have lower bacterial counts than milk produced under mechanised milking in temperate countries (IDF, 1968). An interview with local Maasai pastoralists revealed that morning milk would normally still be used for preparation of boiled tea in the morning of the second day i.e. after a 24 hour period. More detailed information on the bacteriological quality of milk under traditional milking practices is required before one can make more definite conclusions on its potential shelf-life under uncooled storage in a tropical environment.

2. SOUTHERN AND EASTERN AFRICA - ETHIOPIA.

Ethiopians have used milk as part of their diet for centuries. The importance of milk in the diet of the people differs according to the farming system. In the highlands, the rural people are sedentary farmers raising both livestock and crops. The main part of their diet consists of cereals and legumes. Milk is used for rearing calves, children, and whatever is obtained over and above is soured for beverage (irgo) and/or butter making. Soured butter milk is used for human consumption or for local cheese (ayib) production.

Amongst the lowland people, mainly pastoralists and agro-pastoralists, milk forms a major part

of their diet. The production varies according to season. In the dry season, little milk is available. However, since they own a number of milking animals, they have some milk for home consumption over and above that for calf rearing, unless it is a severe drought.

According to reports (Ministry of Agriculture, October 1979 and 1980) an estimated total of about 1.4 million metric tons of milk is produced in the country from an estimated population of 4.6 million cows, 9.3 million goats, 3 million ewes and 0.15 million camels. On a national scale the per capita milk consumption is estimated at 19 to 30 kg per annum.

3. WEST AFRICA - MALI.

According to the Production Yearbook for 1986 of the Food and Agricultural Organization of the United Nations, the total milk production in Mali is about 155,000 metric tons per annum. about 61 per cent, 18 per cent and 21 per cent of this total is produced by cattle, sheep and goats respectively. The bulk of the cattle milk is produced by pastoralists and agro-pastoralists, where about 65 per cent of the national herd are found (Ministere Charge du Development Rural, 1982). There are large regional and seasonal differences in milk production. Owing to lack of transport facilities and relatively poor road networks, the surplus milk from the distant milk areas, cannot reach the consumer areas. Thus, this has resulted in imports of dairy products of about 7108 metric tons according to the Food and Agricultural Organization of the United Nations report (Trade Yearbook, 1986). According to the Food and Agriculture Organization of the United Nations (1983b), more than half of the total imports are consumed in the capital, Bamako.

Except for those producers who are near and around urban centres, the majority of them have no milk markets. Thus the milk produced by the pastoralists and agro-pastoralists are mainly used by the family.

4. SOUTHCONE COUNTRIES OF LATIN AMERICA.

These countries are located from the Equator line to parallel 40.

Southcone countries of Latin America can be divided into three main groups according to the following:-

1. **Amount of milk produced by the country.**
2. **Level of dairy technology applied.**
3. **Relationship between total milk production and milk used at the industrial dairy factories, as well as milk used to elaborate traditional dairy products on a small scale or to sell raw milk directly to the consumers.**
4. **Average milk consumption per person per year.**
5. **Level of milk self-sufficiency in each country i.e. are they traditionally exporter or importer countries.**
6. **Existence of specilized organisations in the country to assist the sector technically.**

4.1 ARGENTINA AND URUGUAY.

These countries are the only traditional dairy exporting countries of Latin America, thus their dairy production and processing sector have been induced to increase milk production, to adopt new technology, etc. in order to obtain dairy products in sufficient quantity and of the quality required for export. Argentina is the second milk producer in Latin America with more

than 5000 million litres per year (from 1975 on) and an average milk consumption of 109 litres/person/year in 1986. In addition, large dairy industry organisations and companies and big farms have a good economic capacity to promote research work and help to create technical and scientific organisations specialized in milk production and processing such as CITIL (Dairy Industry Technological Research Centre), CERELA (Lactobacillus Reference Centre) and others.

Table 5. Milk Production in Southcone Countries of Latin America (million litres)

	1979/81	1984	1985	1986
	(Annual average for the period)			
Argentina	5.311	5.200	5.823	6.200
Bolivia	71	90	95	95
Brazil	11.378	12.303	12.580	11.860
Chile	1.078	880	1.012	1.093
Paraguay	163	175	190	190
Peru	796	780	809	829
Uruguay	811	851	893	920

Source:

- 1986 FAO Production Yearbook. Vol. 40. Rome 1987

- Chilean Agricultural Ministry. Agricultural Planning Office. MilkBulletin 1987.

Table 6. Milk Production per capita (2) per year (litres)

	1985	1986

Argentina	190.5	199.9(1)
Bolivia	14.9	14.5
Brazil	92.8	84.1
Chile	84.1	89.4
Paraguay	51.6	50.2
Peru	41.1	41.0
Uruguay	296.5	303.1(1)

(1) Exporter countries

(2) It is not milk consumption average

Uruguay has the highest milk consumption in Latin America, about 190 litres per head of population per year. Its total milk production in 1986 was 920 million litres. It has a very unique farmer organisation (similar to the Milk Marketing Boards of the United Kingdom) where the large milk farmers are owners of several big factories, so in an indirect way they sell their own milk for manufacture into dairy products getting the best prices for the milk produced. In addition, several other benefits such as technical assistance, low priced raw materials, etc., are provided by the same organisation, and this is the reason why most of the milk produced in Uruguay is sent to the dairy factory and the small remainder is used for traditional dairy products.

In this way, traditional dairy products are not economically attractive for dairy farmers in Argentina and Uruguay and the amount of milk used for them is minimal.

4.2 BRAZIL AND CHILE.

These countries may be taken as one group even though they are not geographically close and they have difference climates. Nevertheless both have a relatively well developed dairy sector which included many technical advances. Additionally both have technical assistance through specialised organisations such as the Milk Technology Centre, Valdivia (CTL) in Chile and Candido Tostes Milk Institute, Minas Gerais, Brazil. However these countries are not able by themselves to provide enought milk for the consumption needs of their own populations so both are traditional importer countries of milk products.

Brazil has the largest milk production in Latin America and ranks as 7th in the world with a milk production of 11,860 million litres in 1986 but its large population of around 141 million inhabitants allows only a consumption average pf 84.1 litres of milk per person from its own milk supply.

In the case of Chile, milk production volumes of 1,012 million litres in 1985, 1,093 in 1986 and 1,100 in 1987 were obtained and its average milk consumption per head of population from its own production only amounts to 89.4 litres of milk per year.

In addition, both countries have some similar difficulties, which do not permit them to improve their dairy sectors as they might wish, particularly in milk production. Both have a great number of small farmers which are not so efficient for various reasons. Many of these farmers do not sell their milk to the dairy factory but sell it directly to the consumers in liquid form or as traditional cheese or other typical dairy products. In the particular case of Chile around 40 per cent of total milk produced does not go to the dairy factory, so the small dairy product makers in Chile make up a very important part of the dairy sector.

4.3 PERU, BOLIVIA AND PARAGUAY.

This group is the least developed in dairy production of the three southcone groups. Peru and Bolivia belong to the Andean area and Paraguay to the tropical one, but all of them have relatively poor weather conditions for milk production, which despite natural disadvantages could be developed but with more difficulty than the countries of the other groups.

There are very few dairy factories in these countries. Normally the existing factories do not employ much technology and they have very little capacity for milk processing.

Normally, there are some international dairy factories as well, such as European (Nestle) and USA factories with large capacities for milk processing which produce specific types of product like powdered milk, and evaporated and condensed milks.

Consequently in the countries of this group a large proportion of the available fresh milk is used on the farm of production to prepare traditional dairy products using very simple equipment and a rudimentary method. Alternatively raw milk is sold directly to the consumer. Due to imprecise legislation, if any exists, raw milk marketing or dairy product preparation from raw milk is currently allowed.

Therefore, the main countries involved in the preparation of traditional dairy products are the least developed in the general dairy production sector, that is to say countries from Group 4.3 (Peru, Bolivia and Paraguay), followed by countries of Group 4.2 (Chile and Brazil). Group 4.1 countries (especially Uruguay) are practically irrelevant in traditional dairy products made on dairy farms.

5. MIDDLE EAST - SYRIA.

Milk production in Syria is based on cow milk (48 per cent), sheep milk (45 per cent) and goat milk (7 per cent).

In the past ten years, cow and sheep milk production has more than doubled, but the country still continues to import a sizeable amount of milk and its products.

However, the government of Syria has made and is making considerable efforts and investments in order to develop this sector of animal production and progress has been achieved in many areas, for example in the establishment of high yielding herds of exotic breeds (such as the Freisian) located on state farms as well as the development of artificial insemination services and distribution of feedstuffs.

However, many problems still remain in the production, processing and marketing areas that need additional efforts and inputs to address the major constraints that continue to limit the development of the milk production sector.

The main sources of milk in Syria are cows, sheep and goats in this order of quantity of milk produced. Table 7 shows the total population of cattle, sheep and goats from 1963 to 1987.

Table 7: Total numbers of cattle sheep and goats in Syria from 1963 until 1987 (thousand)

Year	Cattle	Sheep	Goat
1963	451	4,297	581
1970	506	5,455	741
1975	557	5,809	814
1980	768	9,301	1,025
1981	807	10,504	1,060
1982	792	11,403	1,150
1983	767	13,360	1,157
1984	736	12,693	1,060

1985	742	10,993	1,059
1986	706	11,669	1,006
1987	710	12,668	1,002

From Table 7 it may be seen that in 1987 the total population of cattle in Syria was 710,000 head consisting of about 285,200 lactating cows producing 583,300 metric tons of milk of which 293,384 metric tons were consumed as fresh milk around the main cities and production centres.

Cow milk from Syria comes from two main sources:-

One source is state farms and governmental cattle centres. The second source is the private sector producers or small holder farmers.

The governmental centres or cattle stations have only about 3037 lactating cows producing 13,937 metric tons of milk which represents only 2 per cent of the total produced in Syria.

The remaining part of the cattle population of Syria is owned by the private sector which is considered as the most important contributor to milk production since it contributes 98 per cent of the total cow milk output.

The herd size of the small holders ranges between 1 and 10 cattle. Milk production from cows is summarized in table 8.

Table 8: Numbers and yield averages of cow breeds in Syria (head)

Breed	Total Number	Average Yield head/lactation	Total Yield (metric tons)

		(nearest kg)	
Local breeds			
(Akshi & Jolani)	123,985	949,292	117,698
Freisian	92,300	3420,975	315,756
Cross bred			
(local)	49,215	2264,472	111,446
Shami	19,700	1934,010	38,100
Total	285,200		583,000

Milk production on the state farms is high; the average lactational milk production per cow is over 4500 kg. This yield compares favourably with yields obtained from milking cows in the developed countries. However, the national average milk production per cow per lactation continues to be low at around 1600 kg.

The second source of milk production in Syria is sheep and more specifically the local Awassi breed which is considered the national breed in Syria, the national flock totals about 14 million head. At present more than 80 per cent of the flock grazes in the steppe region in nomadic flocks. Unfortunately, the steppe area does not have the capacity to support the existing number of sheep and consequently over-grazing has led to deterioration of the feed base in the steppe.

The 14 million head of sheep has about 7,624,071 head of lactating ewes producing about 457,215 metric tons of raw milk with an average production of 59.9 kg per head per lactation. An amount of 5,943 metric tons are consumed as fresh milk around the production centres but 80 per cent is converted into dairy products.

As regards the milk production from sheep, the governmental centres have 5,976,000 head of sheep producing about 358,000 metric tons of milk the remaining 59,215 metric tons being produced by nomadic flocks in the steppe area which mostly depend on natural range and grasslands for sheep feeding.

Goats are the third most important source of milk in Syria. The total number of goats in Syria is 1,002,000 head of which 666,126 are lactating females producing about 66,977 metric tons of milk annually with an average of 100.5 kg per head per lactation.

About 20,402 metric tons which represents 30 per cent of the total goat milk production are consumed as fresh milk. The breeds of goats and their milk production are shown in Table 9.

Table 9. Breeds of Goats and their Milk Production in Syria.

Breeds	Total Number	Average Yield (kg/head/lactation)	Total Yield (metric tons)
Shami	77,117	283	14,292
Mountain	924,983	97	53,685
	1,002,100		66,977

Syria has had a few buffaloes since 1985. The herd number about 1,123 head producing about 852 metric tons of milk, and is located in a very narrow strip, around Homs, Hama and the Al Ghab plain.

In summary, the annual milk production in Syria amounts to 1,107,907 metric tons of which about 373,217 metric tons (35 per cent of the total) are consumed as fresh milk.

Only 5 per cent of the annual production is converted into ghee (butter oil), 31 per cent is

processed into local cheese and about 5 per cent is made into butter, the rest is processed into other products such as labaneh, shenglish, karisheh etc.

Until now there are no governmental centres for milk production from goats but goat raising is carried out by some crop farmers and with the nomadic sheep flocks.

6. ASIA.

6.1 INDIA AND NEIGHBOURING COUNTRIES. Traditional Aspects.

Pastoral economy formed the basis of the Indo-Aryan civilization which thrived in India long before the Christian Era. Dairying was an integral part of that civilization. It took its roots in the north west part of the country and spread virtually to the whole of the sub-continent. Dairying has been a rural activity in India and the neighbouring countries from time immemorial.

Milk production in India is largely based on the utilisation of crop residues like wheat/paddy straw, millet stovers etc. Since Indian agriculture continues to depend largely on the monsoon rains, the availability of crop residues is highly seasonal. Milk production in India is therefore concentrated between November - February, generally referred to as the flush season. April - September (summer season) are the lean months for milk production. Two thirds of the annual milk production takes place during the four-month flush season.

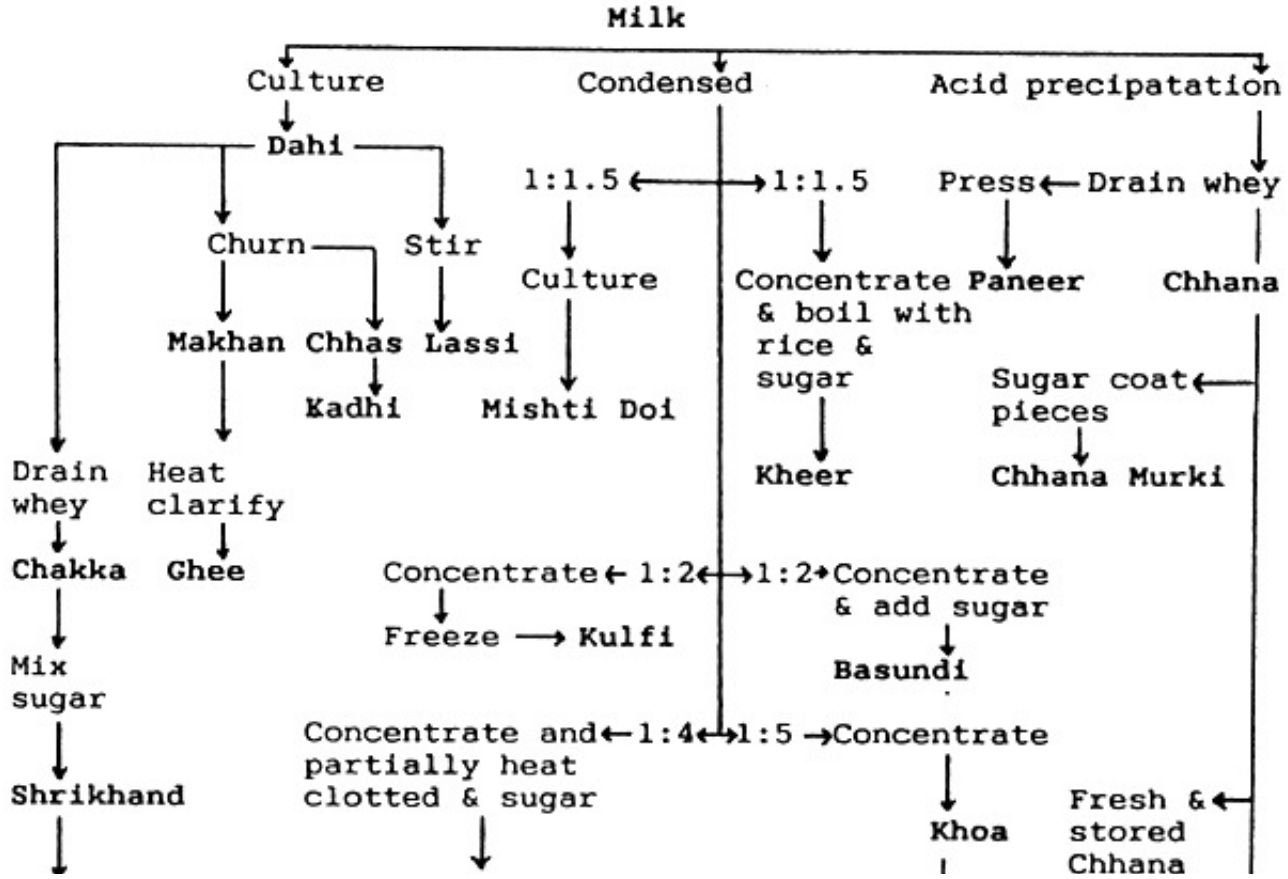
Milk produced in excess of the daily requirements for direct consumption was traditionally converted into various dairy products with a longer shelf life and thus the different methods of preservation of milk began.

Figure 1 shows the flow chart of milk converted into traditional milk products in the region.

Milk Production. The buffalo and the cow and to a very limited extent the goat are the main milch animals in the Indian sub-continent. The buffalo contributes some 64 per cent, the cow 33 per cent and the goat 3 per cent of the total milk produced in India. India has the largest milch animal population in the world. Milk of the camel, sheep and yak is used in some parts of the region.

The cattle and buffalo populations in the Indian sub-continent are shown in Table 10 and the milk production in these countries is shown in Table 11.

Fig 1. Flow chart of conversion of milk into traditional Indian dairy products.



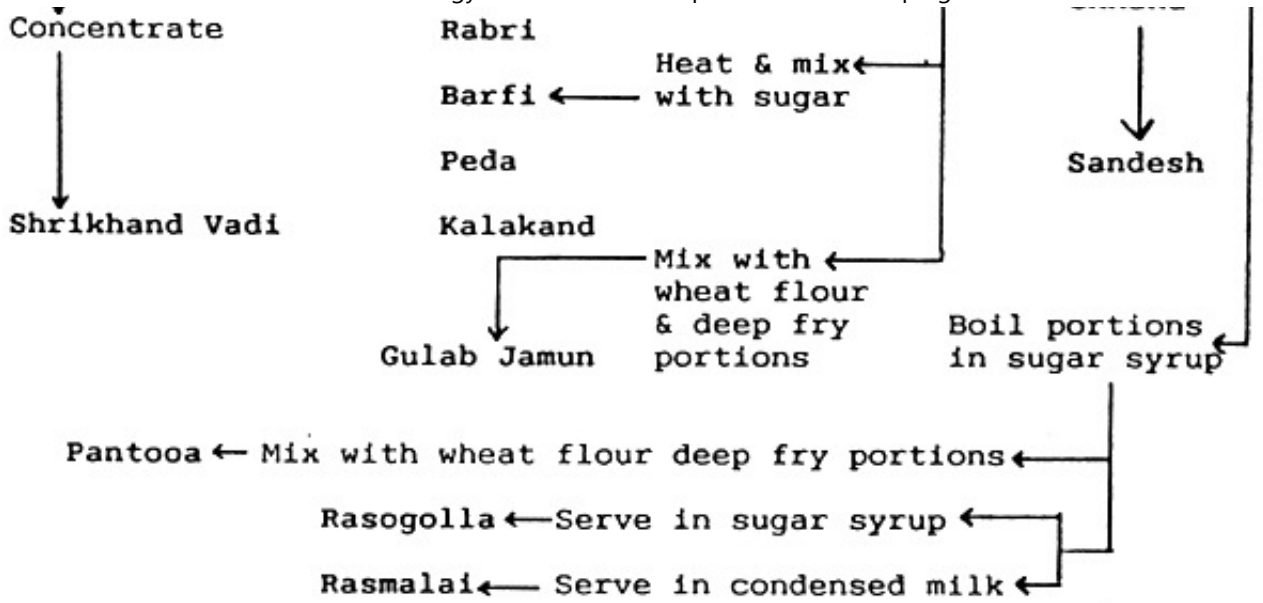


Table 10. Number of cows and buffaloes in the Indian sub-continent.

Country	Cows	Buffalo
	(thousands)	
Bangladesh	23,500	1,900
Bhutan	395	7
India	199,300	74,260
Union of Mynamar	9,912	2,189
Nepal	6,374	2,890
Pakistan	16,951	13,698
Sri Lanka	1,807	1,008

Table 11. Trends in milk production in the Indian sub-continent.

Country	1977	1984	1985	1986

	(thousand metric tons)			
Bangladesh	1,139	1,479	1,479	1,522
Bhutan	27	31	31	31
India	28,500	41,000	42,300	44,000
Union of Mynamar	282	631	649	652
Nepal	718	785	794	805
Pakistan	8,509	10,242	10,856	11,230
Sri Lanka	228	280	289	155

There are several well recognised breeds of cows and buffaloes in the region such as Red Sindhi, Gir, Tharparkar, and Sahiwal among the cows, and Murrah and Neeli Ravi among the buffaloes, are outstanding breeds. The milk of the buffalo is comparatively richer in fat content than that of the cow as shown in Table 1.

Because of the lack of scientific animal husbandry and nutritional practices, the yield of the milch animals in the region has been rather low compared to that of the dairy cow in the advanced dairy countries. A beginning has been made since the middle of this century in the scientific management and feeding of cattle, highlighted by the Operation Flood programme of establishing vertically integrated cooperative dairy projects. The trend towards increased milk production in India is evident from Figure 2. Milk production which amounted to 17 million metric tons in 1950–51 has increased to 46 million tons in 1986–87. It is expected that milk production will increase to 65 million metric tons in 2000 AD. The increase in milk production is to be ascribed to the establishment of rural dairies largely in the cooperative sector. These have contributed to the upgrading of animals, better feeding practices and well organised veterinary services, including artificial insemination. The population of the cross-bred cows and the upgraded buffaloes is expected to increase the milk production significantly.

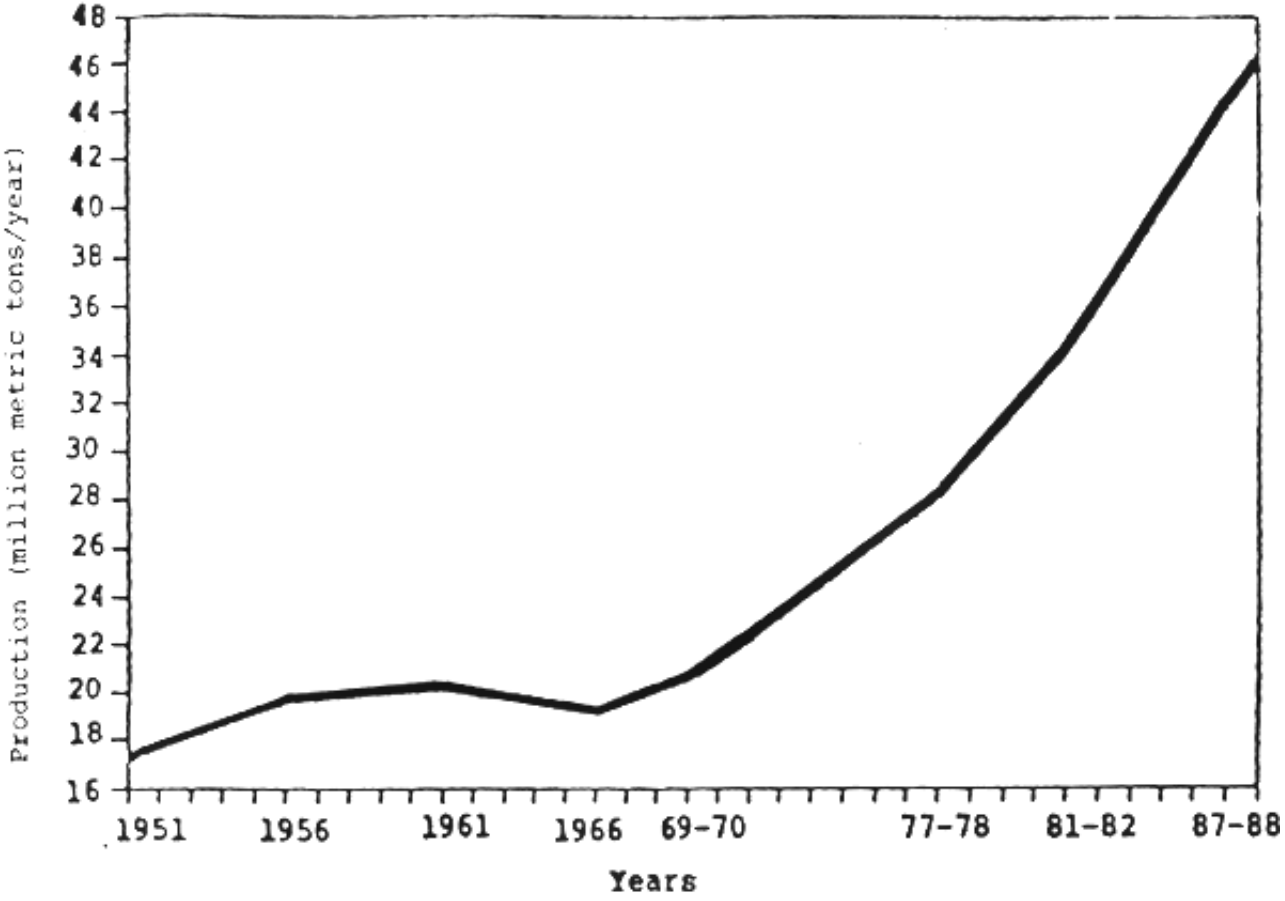
The scientific organisation of Indian dairying started with the establishment of military dairy farms and cooperative milk unions throughout the country towards the end of the nineteenth century. Organised marketing with the application of advanced dairy technology commenced only in 1954 with the establishment of the Amul Dairy which was the first dairy in the region to manufacture milk powder, condensed milk and cheese from buffalo milk. Amul Dairy now handles some one million litres of milk per day.

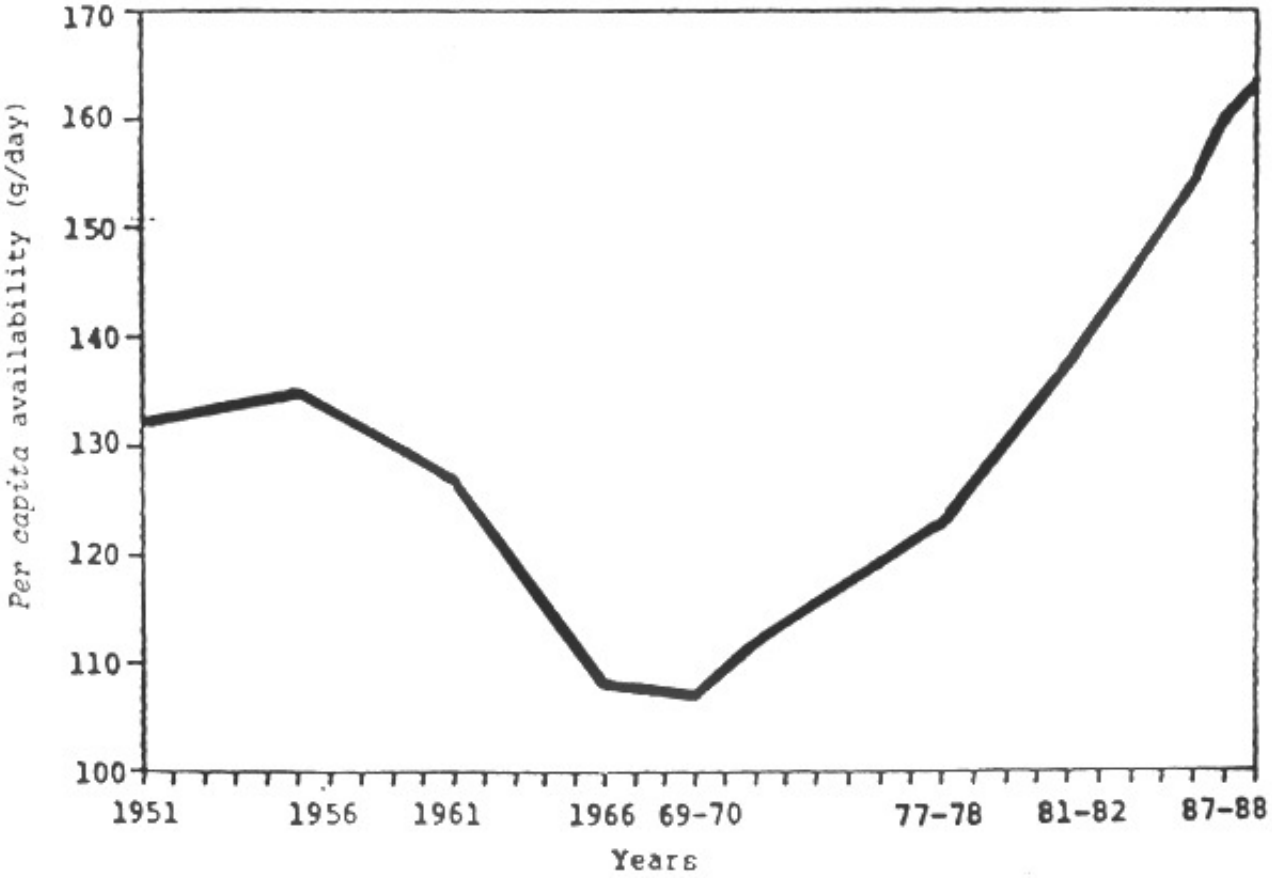
While the rich in India consume the bulk of the milk either as liquid milk or as milk products, the lower income groups consume most of the milk they obtain in tea and coffee as shown in Table 12.

Table 12: Typical Urban Milk Utilisation Pattern in India.

	Rich	Middle	Poor
Number of families	10,000	60,000	30,000
Average amount (litres) of milk used per family per day	3	1	0.3
Use in tea and coffee (per cent)	25	50	90

Fig 2. India - Milk production and *per capita* availability


Production (million metric tons/year)
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
1951
1956
1961
1966
69-70
77-78
81-82
87-88
Years



6.2 HIMALAYAN REGION - NEPAL AND BHUTAN.

For the preparation of traditional milk products, milk is the main source of raw material where the milk cannot be sold as liquid milk. The manufacture of traditional milk products is usually done from the milk of yak or chauri, cow and buffalo. In the alpine region of the Himalayan area, the traditional milk products are generally made from yak, cow and chauri milk. In the midhills and terai the milk is from the cow and buffalo

NEPAL. Livestock are an integral component of the agricultural production systems in Nepal, a

country with a human population of 17,2 millions. Livestock statistics show (Nembang, 1989) that in Nepal in 1987/88 there were 6,343 million cattle, 2,952 million buffalo, 0.2 million yak and chauri (a yak cross-bred with Nepalese cattle), 0.873 million sheep, 5,211 million goats.

The number of cows in milk in the country is estimated to be 0.683 million i.e. 10.8 per cent of the total cattle population. Buffalo in milk are estimated at 0.735 million i.e. 24.9 per cent of total buffalo.

The total milk production from cattle and buffalo is estimated at 808,000 metric tons per year excluding the milk produced by yak and chauries.

The typical Nepalese cow produces milk with 3.6 per cent of fat which compares with 6.5 to 8.0 per cent for the buffalo.

The milk of the yak cow (a nak) is a rich golden colour and has a high fat content of 7–9 per cent.

The Dairy Development Corporation (DDC) received 785,972 kg of yak/chauri milk annually in the cheese factory areas. The remainder of yak/chauri milk in Nepal is converted into traditional milk products where there is no market access for selling the milk in liquid form.

BHUTAN. Bhutan has a human population of 1.2 million. Livestock are an integral component of the agricultural production systems.

There are an estimated 30,000 yaks in Bhutan. These animals and their hybrid crosses provide milk, butter, cheese for home consumption or for sale or exchange for food grains and other necessities.

The chauri produces more milk than the pure-bred yak but the fat content (6 per cent) is slightly less than that (6.5 per cent) given by the yak.

It is estimated that there are about 0.310 million cattle in Bhutan. The predominant breed is the Siri. This breed is crossed with Nepalese cattle to produce a very hardy animal known as the Kachcha siri or imitation siri. Milk production by this animal is quite poor with an average production of 150–250 kg per lactation with calving intervals of about 700 days. The fat content of the milk varies from 6 to 10 per cent.

Jatsam cows (mithun cattle crossed with the siri) produce more milk of higher butter fat content.

Bhutan has 5,700 buffalo, 37,500 sheep and 37,000 goats. Goat rearing is not encouraged by the government because of the danger of damage to the forest.

II MILKING CONDITIONS AND HYGIENE

1. SOUTHERN AND EASTERN AFRICA - GENERAL.

In the traditional sector not all lactating animals are milked. Depending on local traditions and beliefs, sheep and goats may or may not be milked (Nicholson 1984; Boor et al 1987). In the

case of cattle some lactating cows may not be milked due to bad temperament, low milk yields or the cessation of the lactation following the death of a calf. Kurwijila (1988) reported that the average milk yield of local cattle excluding milk taken by the calf is generally considered to be one litre per lactation day although yields of two to three litres per day is common with some types of cattle in Zambia (Bessel and Daplyn, 1977), Sudan (Wilson and Clarke, 1976; Kerven, 1987) and Ethiopia (Nicholson, 1983).

In most cases the cows are watered once a day. Lactating cows are not given any special supplementary feeding but they may be allocated the best pastures available.

During the day the calves are grazed separately.

Milking is usually done twice a day; early in the morning and in the evening. Milking is commonly done outside, beside a restraining wooden post erected near the main kraal or under a tree.

The calf is allowed to suckle to stimulate milk let down and the cow is then milked. The calf is allowed to suckle again before being tethered away from the cows for the night or taken to separate grazing grounds during the day. The milking is done by women or children in most pastoral communities but in some agro-pastoral and mixed farming communities, milking is done exclusively by men.

In most cases no attempt is made to wash the udder before milking. This may be due to the practice of allowing the calf to suckle before milking. This will result in some cleaning of the teats. A bad milking practice which is commonly observed (Kurwijila, 1989) is that of the milker dipping his fingers into the milk as a means of lubricating the teats during milking.

Traditional milking vessels may be carved out of wood (this practice is common with

agropastoral communities around Lake Victoria) but clay pots and gourds, with wide openings, are more common.

Vessels woven out of animal skins are used by pastoralist peoples such as the Borana in Ethiopia, and the Maasai in Kenya and Tanzania.

Shalo (1987) has reported that in some pastoral communities in Kenya a separate gourd is provided for each cow - a family may have as many as twenty or more gourds. The cow is milked direct into the gourd.

The practice of smoking the vessels used for the storage of milk is a common feature of the various pastoral and agropastoral communities in the region. The treatment has the functions of passing the smoke flavour to the milk or milk product and disinfecting (sterilizing) the vessel. Table 13 provided by Kurwijila (1989) lists plant materials including grass, shrubs and hardwoods used by various communities in Ethiopia, Kenya and Tanzania for smoke generation..

Table 13. A preliminary list of plant materials used in the smoking treatment of milk vessels in different African communities.

Country and community	Products made	Plant used in smoking of vessels used in milk storage & processing		Reference
		local name(s)	scientific name	
Ethiopia				
Borana-P	BM,CFM,B,G,	-	Olea africana	Bekele & Kassaye (1985)
"	"	bedana wood	Balanities aegyptica	Bekele & Kassaye (1985)

Kenya				
Maasai-P	BM,B,G	-	-	Shalo (1987)
Samburu-P	BM,B,G	-	-	" "
Nandi-AP**	BM,CFM,B,G	-	-	Shalo (1987)
Kipsigis-AP	"	"	"	" "
Tugen-AP	"	"	"	" "
Tanzania				
Maasai-P	BM,B,G	Msisilo/ Emutego	Diplorhynchus condylaccarpon	Personal communication
Waarusha-AP	"	Msengeni Loliondo	- -	Kurwijila (1989)
Gogo-AP	"	Msaka	-	"
Sukuma-AP	"	Nzukijo	-	"
		Bululambuli	-	"
		Malamata (grass)	-	"
		Kalasala (legume)	-	"
Iraqw-AP	"	-	Combretum spp	"
Zigua-MF***	"	Ngurukila ya		
		Msalaka	-	"
		Msizilo	Diplorhynchus	
			condylaccarpon?	"
Jita-MF	BM,B,G	Mwotwa	Olea africana	Personal communication

		Mchumulilo	-	Kurwijila (1989)
Haya-MF	"	Mkuza nyana		
		Mutoju	-	"
Chagga-MF	"	n.d.	n.d.	"
Pare-MF	"	n.d.	n.d.	"
Nyakusa	FM	n.d.	n.d.	"

Note:

*** P = Pastoralists**

**** AP = Agropastoralists**

***** MF = Mixed Farmers**

BM = Buttermilk

CFM = Concentrated fermented milk

B = Butter

G = Ghee

FM = Straight fermented milk

n.d. = Smoking not done

? = Resemblance of name

Personal communication: information given to compiler during oral survey.

Compilation by Kurwijila (1989)

2. SOUTHERN AND EASTERN AFRICA - ETHIOPIA.

In most cases the milking animals are kept for the night with the rest of the stock in a shade or in an enclosure. Because these places are not kept clean except for the removal of dung the milking cows become soiled with dung and urine. Since it is not a common practice to clean the udder and hindquarters before milking the milk is contaminated.

The cows are milked in the shade, kraal, grazing field and in front of the homestead, none of which are clean environments for milking. The standard of hygiene of milk production is considered unsatisfactory.

Milking vessels are normally made from woven grass, wood fibre, calabash, hollowed wood or skin. Disinfection is difficult and because the vessels are wide mouthed, flies, dust and dirt may easily gain access during milking.

Bekele (1989) reports that the milking vessel is thoroughly washed before the smoking treatment. He considers the cleanliness of the washing water to be doubtful. The disinfecting effect of the smoking treatment is brought about by the hot embers placed in the vessels for a few minutes. In the highlands Olea aficana is the only source of material for smoking whereas in the lowlands the same plant as well as Acacia busia will be used as available.

3. WEST AFRICA - MALI.

Traditionally the cattle are kept overnight in enclosures near the homestead and milking is generally done in the enclosures. At times when the animals are sent out for early morning grazing near to the homestead, the milking is done in the grazing field.

Bekele (1989) reports that the containers used for milking and storage are made of calabash. They are bowl-like vessels which are washed and kept clean.

The cows are not cleaned before milking and as the milking environment is not clean, the milk is not clean. He concludes that milking conditions and hygiene are far below the requirements for clean milk production.

4. SOUTHCONE COUNTRIES OF LATIN AMERICA.

Brito (1989) considers that this is the main point in which each of the southcone countries of Latin America has very particular characteristics.

In the case of Argentina, Brazil, Chile and Uruguay, new technology e.g. milking equipment and cooling tanks have been introduced, mainly at medium and large farms. In general in the other southcone countries, i.e. Bolivia, Paraguay and Peru, the milking system, milking management and work at the farm are very simple and traditional.

Milk quality and milk production conditions of the main southcone countries may be summarised as follows:-

a. **there are no appropriate breeds for a tropical or Andean zone;**

b. **cows are heavily infected with parasites, gastro-intestinal illness and reproductive illnesses which create difficulties for the development of dairy production;**

c. due to the long periods of drought after heavy rains, feeding is difficult and the digestibility of feeds is poor. The use of concentrates for cows is not possible because of cost.

   Cow feeding is one of the main problems for small farmers in all southcone countries;

d. There is an insufficient regional infrastructure for milk production at the highest level of efficiency;

e. Very small farms are normally involved in milk production but the farmers need more knowledge on milk production and dairy technology;

f. Small dairy farmers have limited enterprise capacity and need credit and other economical assistance.

4.1 ARGENTINA - URUGUAY

ARGENTINA. More than half of the 4,400 farms producing milk in Argentina produce less than 100 litres per day and these farms are of low economic capacity and unsuitable structure to produce milk. Milk quality is very variable, the better milk comes from big and medium-sized farms which mainly supply the big factories which normally pay for milk quality.

The small farm which supplies the small dairy processing units produces milk of lower quality, consequently traditional products are generally made from poor quality raw milk.

URUGUAY. There are about 8,900 milk-producing farms and around 5,000 of these are specialised in milk production. Over 40 per cent of the farms are classified as small with around 50 hectares of land. Since 1980 the milk production sector has evolved greatly:-

a. by increases in milk production and technological changes at the milk processing dairies;

b. milk supplied to the dairy factories has grown by around 80 per cent;

c. milk processing capacity has increased by about 60 per cent;

d. milk export values have shown a large increase from around 4.3 million dollars in 1978 to 40 million dollars in 1983.

The Government is responsible for the quality control of dairy products for export and for the general control and hygiene legislation for the dairy industry.

In order to regulate the minimum requirements for cheese production at a dairy farm a specific regulation was established in Uruguay in 1984. Dairy farms producing cheese - an example of traditional milk product manufacture - and not selling milk to the large industrialised farmer cooperatives which have around 90 per cent of the industrial capacity, do not have technical assistance, or credit or other benefits such as those provided for the milk producers who are members of the cooperatives.

The Government aid for dairy farmers particularly the very small farmers are much reduced. Nevertheless the general incentive of dairy product export and the technological improvement by means of milk cooling systems have brought about an improvement in milk quality, particularly at large and medium-sized dairy farms. The small dairy farms have not improved milk quality in the same way as the large farms.

4.2 CHILE - BRAZIL

CHILE. At the present time there are an estimated 25,000 farmers producing milk in Chile.

Around 70 per cent of them are very small farmers with 5–19 cows each, 25 per cent of medium-sized herds of 20 to 99 cows and the remaining 5 per cent with more than 100 cows each.

Small farmers are the main suppliers to small dairy processing units. They are of very low educational level (around 4 years of primary school), the units are of low economical capacity with few possibilities for enterprise and the farm equipment is very rustic.

They are not very efficient and so their milk production, in terms of quantity and quality, does not change over several years. As in other countries the main problems with milk production are caused by very low supplementary feeding for the cows mainly due to the high cost of these products.

In 1977, rules were introduced in Chile to classify the milk according to quality characteristics at dairy factories.

The classification systems include hygiene tests such as methylene blue reduction time and somatic cell count. Checks for extraneous water by cryoscope and density measurement are made. While there is no obligation to pay for quality, in general the dairy factories give an additional payment for better quality milk to encourage the dairy farmers.

The price paid to the farmer is normally based on the following components:-

a. **a basic price for each 3 per cent of fat per litre of milk received;**

b. **additional payment for fat as a monthly average.**

c. **quality level, based on the supply meeting the A, B or C grade requirements of the official**

classification;

d. **seasonal adjustment;**

e. **cost of provision of cooling equipment.**

Small dairy farmers remain under difficult economic conditions and several have set up small dairy processing units because in this way they could obtain better prices for their milk without improving the quality of their supply.

Traditional dairy products are normally made with raw milk which gives a poor quality end-product particularly in relation to its microbiological characteristics.

Fortunately, the important diseases such as tuberculosis and brucellosis have been eliminated but other pathogens are normally present in the end-products.

Milk collection centres have been established through a technical project financed by the National Development Corporation (CORFO) and carried out by the Milk Technology Centre (CTL) in conjunction with the dairy factories which is helping to improve milk quality.

BRAZIL. This country has the largest production of milk in Latin America. In 1986 the production amounted to 11,000 million litres. Milk production areas are concentrated in south-east regions (43 per cent), the south region (30 per cent), central-west region (17 per cent) and north-east (10 per cent).

North-east and central-west region farms are least efficient and have low technological development. The south-east region has the biggest variety of technological development, from low to high technology applications. More than half of the milk produced in this region (43

per cent of the total milk produced in Brazil) comes from small farms (less than 100 litres per day). The south region has the best technological level of the country with the highest annual average yield of 1,300 litres per cow. This compares with the national annual average of about 700 litres per cow.

Zebu and buffalo are the main milk producing animals in the north; the central-west region has Dutch (Holland), Swiss, Jersey and Guernsey breeds of cow. The south-east region has european breeds either pure or crossed with the Zebu, while the south region has Dutch (Holland), Jersey, Guernsey and Hereford.

In 1980 only 59 per cent of the milk produced was delivered to the dairy factories, the remaining 41 per cent being used at the farm for calf rearing, human consumption at the farm or direct sale to the consumer and traditional dairy product processing. Regulations exist in respect of milk production and milk quality and define the requirements for dairy buildings, their location and hygienic conditions.

A project on traditional cheese made in small dairy processing units in Minas Gerais province indicated that many of the small farmers had no effective sanitary control of milk production and a high incidence of brucellosis in the cows in small farms.

4.3 BOLIVIA - PERU - PARAGUAY

BOLIVIA. All milk production areas are located in tropical regions. The dairy farms are small; in the Altiplano area around 94 per cent of the farms have less than 10 cows, 5 per cent have between 10 and 30 cows and 1 per cent have more than 30 cows.

The small dairy farmers live in very difficult conditions - subsistence agriculture, no technical inputs, no financial help or credit.

There is no veterinary control of the cows and the feeding is frequently unsuitable for best milk production. There is a high incidence of tuberculosis and brucellosis in the cows and the milk is generally of poor quality.

The Dairy Development Plan, initialised in 1971 and bringing together the Bolivian Development Corporation, the Food and Agricultural Organization (FAO) and dairy factories, has brought about several improvements in the dairy sector including the establishment of five dairy factories in the main dairy zones.

Further improvements in milk production and processing are envisaged as the result of two initiatives:

(a) the decision of the Supreme Legislation No 20474 of 12th September 1984 by which the Bolivian Planning and Coordination Ministry should be in charge of planning the increased scale and efficiency of dairy processing, and (b) a current dairy development project by the Bolivian Government, the United Nations and the Royal Government of Denmark to obtain special credits on equipment for dairy farms and factories.

PERU. There are three main dairy production areas:- the Sierra where most of the dairy farms are located; the Coastal area; and the jungle. Two thirds of farms have from 1 to 5 cows and with the farms which have from 6 to 20 cows the small producer sector makes up 96.8 per cent of the milk-producing farms.

The main problems facing the small farmer is the low volume of milk produced by his animals and milk quality.

A special commission has been formed by representatives of associations of milk producers, processors and the public agricultural sector to determine the basis for obtaining integral

organisation of the small dairy farming sub-sector to develop the agricultural activity.

PARAGUAY. The main milk supply areas are Asuncion zone, Mennonitas of Chaco and Pto. Stroessner.

The small farmer with 1 to 2 cows makes up 81 per cent of the milk production units in Asuncion zone which accounted for 14.5 per cent of the national supply of 190 million litres in 1986.

Problems exist in relation to animal health. Vaccination against foot and mouth disease is compulsory but several important diseases such as Tuberculosis and Brucellosis have no compulsory veterinary control.

The problems of the small-scale dairy farmer in Paraguay are similar to those of other southcone countries of Latin America.

5. MIDDLE EAST- SYRIA.

Veterinary health services are provided to cattle stations or governmental milk production centres to ensure that the dairy herd is free from any infectious disease which could be transmitted to humans through milk or its products. Suspect animals are isolated for treatment and their milk is destroyed.

Staff of cattle stations or government centres for milk production follow strict and detailed technical and hygienic procedures for milk production. Milk is usually collected by lorries from the cattle stations or centres for milk production once a day. Twice daily collection may be arranged in hot weather.

A few private sector milk producers are adopting the milk production procedures of the cattle stations and are using milking parlours or bucket milking machines and they are very aware of the need for producing milk of high quality.

The majority of private sector farmers carry out the milking process in primitive conditions using hand milking. They do not pay attention to the quality of the milk produced, but due to the high demand for milk and its products in the regions, they can sell a product of inferior quality. The private sector producers are often not aware of health problems until it is too late to treat the animals.

In the case of sheep and goats, which are very important components of the dairy industry of Syria, the milking process is done by the farmers themselves in very primitive conditions. Hand milking is normal.

Nomadic flocks in the steppe and the adjacent are subject to periodical vaccination programmes against contagious or endemic disease. Veterinary centres of the Ministry of Agriculture distributed in the regions where the animals are located are responsible for the vaccination programmes.

Many mobile veterinary units operate in the Syrian steppe to treat any health case which may be difficult for the breeder to diagnose or to treat.

6. ASIA.

6.1 INDIA AND NEIGHBOURING COUNTRIES.

Most of the milk in India and the neighbouring countries is produced in the villages by farmers with small land holdings and also by landless agricultural labourers. Although an increasing

portion of the milk produced is collected by the cooperatives and other organised dairies, a significant portion of the milk is still being converted into traditional dairy products due to lack of refrigeration and transportation facilities.

Conditions under which milk is produced in the villages are far from satisfactory, mainly because of the economic backwardness of the producers. The milk animals are housed in a part of the living space of the family or in small closed or open yards adjacent to the family house. Flooring is usually a plaster of mud. The cows are rarely washed before milking. Buffaloes generally wallow in ponds, especially in the hot summer months.

Milking is done by hand, usually after suckling by the calf. Except in a few modern large farms, milking machines are not used. Because of the distances between the producing and consuming points, milk is unavoidably held at ambient temperatures for a significantly long time leading to high microbial growth. The high ambient temperatures in the region for the major part of the year support rapid microbial growth.

The predominant types of microflora in milk received in dairies are coliforms, micrococci, lactic streptococci, spore-forming aerobes and corynebacteria, the majority of these being contaminants from milk utensils. There is also a high incidence of thermoduric bacteria.

An indication of the bacteriological condition of milks in India is given by Aneja (1989) below who concluded that the bacterial counts of raw milk are generally high.

Table 14. The bacterial counts of village milks in India

Season	Stage	Total Count/ml ('000)
Winter	At milking	29
	At dispatch (bulked supplies)	97

	Distribution	211
	Market place	438
Summer	At milking	78
	At dispatch (bulked supplies)	529
	Distribution	1,316
	Market place	3,440

In a further reference to milk quality the total count and thermoduric counts of raw milk are given by Aneja.

Table 15. Microbial quality of raw milk received by two dairies in India.

	Weighing tank	Dump tank	Storage tank
Dairy A			
Total count/ml	13 million	18 million	9 million
Thermoduric count/ml	14,000	120,000	150,000
Dairy B			
Total count/ml	21 million	19 million	25 million
Thermoduric count/ml	2,200	4,200	5,000

These results illustrate that while the total count of the raw milks are similar, the numbers of thermoduric bacteria in the milks are very different.

Aneja (1989) comments that most milk in India and the neighbouring countries is boiled immediately after milking and usually served piping hot for direct consumption. Consuming hot sugared milk before going to bed is a regular practice particularly in the north-west part of the region.

6.2 HIMALAYAN REGION - NEPAL AND BHUTAN.

In the Himalayan area, particularly in Nepal and Bhutan, milking of the milk-producing animals such as yak/chauri, cow or buffalo is done by hand. At the time of milking, the hands of the milker as well as the udder of the animal or the milking utensils are seldom properly washed.

In the mountainous regions in yak herds, washing of hands and milking pails is not done because of the cold climate. There is no filtration of the milk. The milking pails which are made of wood, known as lazum are not washed properly. In most places the fermentation of milk is done in the same container as is used for milking.

Farmers lack practical knowledge of proper milk hygiene measures. The problems are more serious in the mountainous regions in the yak herds.

Similarly, very few farmers in the areas of the country where cows and buffalo are the milk animals have adequate knowledge of hygienic milk production.

In the case of liquid milk retailing the malpractice of adulterating milk by adding water is extensive but in the mountainous regions this does often occur (Nembang, 1989).

In the mountainous regions of Nepal and Bhutan, the yak/chauri herds are kept in the open fields all year round. They are milked under all kinds of weather and contamination of the milk is practically inevitable especially when the animals are dripping wet during the period of the monsoon.

III LEVEL OF PROCESSING

1. SOUTHERN AND EASTERN AFRICA - GENERAL.

Traditionally milk is either consumed raw or allowed to ferment naturally but is rarely boiled unless used for tea making. In fact in some communities such as among the Maasai it is a taboo to heat milk (Shalo, 1987). However among the settled farmers in western Kenya, boiling of milk is a common practice except when it is meant for the production of sour milk (Boor et al 1987).

Among the pastoralists, milk is a major component of the traditional diet and as such most of the milk produced is consumed in the home and is rarely sold. Hence conversion of any surplus liquid milk to any of the traditional milk products has always been done at the household level. There is no record, historical or contemporary, to show that milk processing has ever been organised at the community level such as is the case with the harvesting, threshing and winnowing of millets, paddy or sorghum or in the hunting of wildlife.

The fact that milk processing is confined to the household level, and the amount of milk processed is usually small, means that the equipment and vessels used as well as the techniques, have remained simple for a very long time. The main products made include fermented milk, butter and ghee and in a few cases cheese curds or concentrated fermented milk foods with enhanced keeping quality.

Estimates of the amounts of milk available in the countries of southern and eastern Africa for traditional milk products are given in Table 4.

2. SOUTHERN AND EASTERN AFRICA - ETHIOPIA.

Traditionally, milking and processing are the affairs of each family. The milk for processing can either be an accumulation from a single milk animal or from a larger number of animals. The milk thus accumulated is processed into different products by each household. Industrial level processing is done by the government plants in Addis Ababa and Asmara. These two plants collect milk from rural areas in the proximity of all-weather roads and within a maximum radius of 120 km from the plant.

In recent years, some producer cooperatives which have local and cross-bred dairy herds, and who are away from liquid milk markets, communally process their milk. They use a cream separator and butter churn, which are imported and manually operated.

3. WEST AFRICA - MALI.

Traditionally milk processing is done at the family level. The milk from a milk animal or a herd or flock is kept in a calabash container. Whatever milk is available for processing into traditional products is done by the housewife.

The only industrial processing in Mail is done by Union Laitiere de Bamako (ULB). The ULB has a capacity of 30 thousand litres a day, operating in two shifts. The plant is supplied with fresh milk from the surrounding producers and hawkers on a twice-daily basis. ULB pasteurizes the whole milk and reconstitutes imported milk products. The products from the factory are pasteurized and reconstituted milk, yoghurt flavoured, sweetened and without additives, fermented milk, sour and sweet cream, table butter and ghee.

4. SOUTHCONE COUNTRIES OF LATIN AMERICA.

4.1 Dairy factories - industrial dairy products.

From the point of view of the relationship between the milk used by the big factories and that processed at farm dairy units, the exporter countries Argentina and Uruguay take the first place for proportion of milk utilized in industrial units. The next group comprises Chile and Brazil who both use large amounts of milk in dairy factories too but farm product marketing in the country is also important in the industrial dairy plants. Finally, Peru, Bolivia and Paraguay are joined in a group because the milk supply is manufactured into dairy product mainly by the individual farmer (see Table 16).

Table 16. Total milk production of southcone countries of Latin America in 1986 and usage at factory and farm levels (million litres)

	Total milk production (1) (2)	Milk used at the dairy factory	Milk remaining at farm (3)
Argentina	6.200	5.580 (90%)	620 (10%)
Bolivia	95	24 (25%)	71 (75%)
Brazil	11.860	6.997 (59%)	4.863 (41%)
Chile	1.093	666 (60.9%)	427 (39.1%)
Paraguay	190	23 (12%)	167 (88%)
Peru	829	174 (21%)	655 (79%)
Uruguay	920	641 (69%)	289 (31%)

Compilation by Brito (1989)

1. Brazil, Bolivia, Chile and Peru, additionally have goat milk used at farm to produce goat cheese.

2. FAO temporary figure

3. Milk for calf feeding, human consumption at the farm, raw milk directly sold to the consumers and to prepare dairy products at small units (farms).

In Argentina in the industrial dairy sector, cheese is the most important product followed by milk powder and fluid milk. It has a considerable production (around 48.706 metric tons) of Dulce de leche which is a traditional dairy product in several countries in Latin America now made to high quality standards in dairy factories. Uruguay has cheese as its most important product of the dairy factories. Several varieties are produced for domestic use and export. The most important traditional products made both by the industrial sector plants and by small units in Brazil are:- sweetened condensed milk, Prato cheese, fresh and ripened Minas cheese, mozzarella cheese and requeson.

4.2 Small dairy processing units for traditional dairy products.

Generally speaking a large proportion of the milk produced in Latin American countries is not dispatched to the industrial dairy ndustry (Table 16) but is used at the farm to make some dairy products which are very typical in that particular region of the world.

Traditional dairy products are made on a small scale, they are normally sold at a town nearby and the end product is not standardized. However, their production remains related to some particular characteristics in the national dairy production systems and geographical characteristics of the region of the world. The main factors which are responsible for this sort of production in the developing countries are:

a. **There are large distances from the farm to the nearest city where the product could be sold.**

b. **In some regions of those countries, roads are not good enough to make easy and fast transportation of milk to the commercial milk plants in order to provide a fresh and good quality raw material to use at the dairy industry. In some countries during winter time there are villages which become isolated due to the impossibility of transit by their poor roads.**

c. **There are many small dairy farmers who produce a very small amount of milk each day, and being normally located far away from each other the collection costs are very expensive.**

d. **The milk prices, paid by the industrial dairy industry to the small farmers are punishing because:**

- **They are not individually relevant to the small amount of milk produced.**
- **The small farmers cannot bulk their individual milks since it is economically impossible to cool the milk.**
- **Milk production has a very big seasonal relationship. Some small farmers don't milk cows in winter time.**
- **Normally they produce milk of poor quality mainly due to their lack of knowledge about milk production, cow management and feeding, and their small financial capacity.**

Nevertheless, technical projects to improve milk quality have been developed in some of those countries. Most of the small farmers have not adopted new technology. They continue to work with the traditional methods and encounter the traditional troubles mentioned before.

According to the industrial characteristics of the southcone countries of Latin America and

their milk marketing, it is very clear that the main traditional dairy producers are those of group two: Chile and Brazil and group three: Peru, Bolivia and Paraguay.

Since all southcone countries are geographically close and have some common historical conditions there are some traditional products which are made in most of them. This is so for sweetened condensed milk which probably was brought with the Spanish conqueror and is very well known and traditionally included in diets all over these countries. Even so, for between 10–20 years this product has been introduced as an industrial product in Argentina, Brazil, Uruguay and Chile and it has remained until now as one of the typical products made in the small processing units of the dairy farms.

In general, something similar occurs with traditional cheese production. Most have passed from the stage of traditional preparation to that of the industrial factories with the introduction of some new technology to improve the microbiological and organoleptic characteristics of the end product which are somewhat different from other regional cheeses.

Small dairy processing units which produce traditional dairy products in southcone countries of Latin America are normally located at the dairy farm, but some of them are close to the cities. However, the processing units normally belong to a farmer whose milk supply comes only from his own farm or from neighbouring farms as well.

There are very small processing units with only around 30 to 300 litres of milk being processed each day, other with about 1,000 to 3,000 litres per day and finally small factories that process up to 20,000 litres per day (e.g. some units located in the South of Chile: X Region).

Those up to 3,000 litres per day are the truly traditional processing units with the minimum of very rudimentary equipment no electric, heating or power sources. Milk is not pasteurized.

The main building for processing is normally an improved old farm building without special facilities for food processing except in some particular cases, where new ones built under technical specifications which are the same as a factory but on a small scale.

The main traditional dairy processing units are the cheesemaking units where some butter is made with the surplus milk fat from standardization of cheese milk. Butter is a secondary product of a small cheesemaker unit.

These units have a cheese vat made of wood, hard plastic (femoglass), or in the best case, of stainless steel. Moulds are normally made of wood.

Only the very best have stainless steel moulds, plastic is not very much used. A cheese press is also present in the processing units, it is usually a very old design used earlier in grape processing at the farm.

All the other small implements for cheese processing are adopted from home kitchen devices (spoon, knives, etc.). Butter processing equipment normally consists of a very small separator and a small rotary churn made of wood. Packaging of the butter is done by hand. There are no cool rooms or refrigeration equipment for storage. Normally the ripening room is close to the processing area in an old farm building without controlled environment conditions.

In the case of Argentina, even though the main cheese makers are big factories, there are small cheese producers who process around 1000 litres of milk each day. They produce farm cheese from milk which has been heat treated by the low temperature for a long time (LTLT) method. All the cheesemaking practices are manual, pressing is carried out through the use of a weight. Salting is done at ambient temperature.

Normally cheese of poor quality is obtained due to the poor quality raw milk used and the bad

conditions under which the product is made. Because those small farmers are isolated they do not belong as producers supplying a milk factory.

They do not have access to technical help which is offered by the factory only to their own producers. These producers may disappear since their activities became much more difficult from working alone.

According to the individual country there may be regulations, legislation or control of those establishments.

In Brazil for instance, the marketing of farm cheese is forbidden even though it is normally produced and directly sold to the consumers. Consequently, there are no regulations concerning the establishment of small scale farm units or the cheese produced by this group. Fifty-nine per cent of Brazil's milk production was supplied to the dairy factories in 1986 and was subjected to Federal Inspection procedures.

Uruguay on the other hand, has special standards that regulate the minimum requirements for cheese making at the farm in order to control the quality of these products.

In the case of Chile there are some standards related to the minimum requirements to build a small processing unit for any dairy product in order to be authorized by the Health Ministry, but only if these requirements are met can the products be sold at any market. In addition the same Ministry eventually makes quality control of the products in the same way as for the products of big factory products. In spite of this most of the very small processing units (50–300 litres milk/day and some of larger production) are not authorized because they do not have financial capacity to implement the minimum requirements of the Health Ministry and most of them are temporary processors and sell their products in an informal market, that is to say an

open market, and the product is not controlled by official regulations at all. There are no statistics about this sector.

In Chile there are 126 authorized cheesemaker units located from V Region (Valparaiso) to X Region (Valdivia-Puerto Montt). They are permanent units producing throughout the year and using about 130 million litres of milk per year in the last 5 or 7 years. The first statistical information of this sector dates from 1985.

Authorized small cheesemakers have technical help through a big technical project (from V to X Region) undertaken by the Milk Technology Centre and financed by the Agriculture Ministry from 1985 through which this sector was identified for the first time. The products are systematically controlled, with transfer of medium applied technology to them through a) inspection of establishment b) self-training courses in the regions using a specific manual c) seminars in the region on particular milk production and cheesemaking topics d) theoretical and practical courses (of 1 week duration) on cheesemaking, carried out at the CTL Valdivia, etc.

However, besides the 130 million litres/year used by the authorized small cheesemaker units, there are some other authorized small dairies that process sweetened condensed milk, using part of the milk retained at the farm. Another part of the milk remaining at the farm is sold as raw milk directly to the consumers. This practice is legal in regions where there are no dairy factories, but it is also done in other regions and the milk is sold illegally.

Countries like Peru and Bolivia have had some technical projects in relationship with the development of national cheesemaker units with international help such as Switzerland Technical Aid, e.g. the Cochabamba and Sta. Cruz dairy projects in Bolivia. Through the same technical help 80 rural cheesemaker units have been created in dairying regions of Peru.

In Paraguay, the Memmonitas area has had some special projects to develop milk production, processing and marketing (US$ 10,7000,000 from 1978 onwards). In addition, an interesting project to create a Dairy Centre at the National University of Paraguay has been in progress since 1987 to provide technical help for professionals and workers involved in dairy production in the country.

Despite these developments in the southcone countries of Latin America small processing units and traditional dairy products have not yet been developed to their full potential in accordance with the regional importance of this agricultural subsector. For 5 to 10 years now, people have been realizing that there is an urgent need to encourage special projects to develop in this sector. The national and international projects just mentioned are the first approaches to develop it. Nevertheless more practical national plans should be encouraged to develop it completely in order to have appropriate legislation and policies all over each country.

5. MIDDLE EAST - SYRIA.

The amount of milk available for processing in large industrial plants and the private or smaller factories can reach 35 per cent of the total milk produced in Syria. This amount comes partly from the government centres for milk production from cows and then from sheep and goats.

In some production areas which are quite near to the processing plants some producers sell their milk to these plants. The price of milk is determined according to a 'quality payment system' which may be defined as a system of payment in which the price paid to the producers is determined by defined qualities of the milk which are:

a. **Milk acidity,**

b. **Fat content in the milk,**

c. **Bacteriological content or quality,**

d. **Absence of dust, hair and other extraneous materials.**

Also, there are many co-operatives for small-holders for both cattle and sheep supplying the dairy plants with raw milk to be processed into different products.

Until now, the co-operative movement in the dairy sector does not have the proper structure to effect the dynamic role to advance the industry.

Most milk producers, process the milk produced in their farms into many products such as yoghurt (laban, drained yoghurt (labaneh or laban Mousafa), cream (koshtah), butter (zobdeh), ghee (samneh), cheese (jobneh) and some other national products like shenglish, karisheh and keshkeh.

In manufacturing these products from raw milk, the farmers use very simple methods to process their milk. The processing levels at the villages differ from one region to another according to the final product and the education level of the farmer and his family.

The milk processing level in the villages is not as advanced as in the government plants and can be described as simple methods to store the milk produced in different forms and tastes. The equipment used in the village for milk processing is extremely simple and can be summarised as follows:-

a. **Tin and copper containers, used in milk boiling,**

b. **Kerosene or gas burners used for heating up the milk but the most common way for milk boiling is using shrubs and kindlings as fuel,**

c. **Sacks made of animal skin to hold the cream being churned into butter,**

d. **For manufacturing drained yoghurt (labaneh) some cloth sacks are used to drain off the whey from yoghurt.**

At the governmental level, Syria has three advanced factories in Damascus, Aleppo and Homs as well as the Syrian - Saudi company factory which was established in 1979.

Each factory consists of different production lines (yoghurt cheese, ghee etc.) and the equipment and machinery used ranges from rather outdated models to modern sophisticated process lines.

As mentioned earlier, the government cattle stations and some co-operatives and some smallholder farmers supply these factories with raw milk. The milk which is to be processed in these factories is handled under hygienic conditions in order to maintain the good quality.

Table 17 refers to the amount of milk processed between 1983–1987 into different products.

Table 17. Quantities of milk processed into products from 1983–1987 (metric tons)

Item	1983	1984	1985	1986	1987
Pasteurised milk	7,576	9,065	8,408	9,582	8,940
Butter	2,283	1,154	2,154	1,477	1,154
Yoghurt	18,163	21,190	19,905	8,037	14,337

6. ASIA

6.1 INDIA AND NEIGHBOURING COUNTRIES.

Level of Production. Milk is mostly produced in small quantities, of 2–4 litres, by small and marginal farmers in numerous and widely scattered villages. The farmers whose principal occupation is agriculture, keep a few cows or buffaloes for milk production (2–4 animals on an average) as a supplementary source of income. Table 18 (see page 46) shows the size of land holdings of typical farmers. It can be seen that the bulk of the animals are held by small and marginal farmers and surprisingly not by large farmers.

The collection, transport and distribution of fluid milk under the tropical conditions prevailing in India and the neighbouring countries present many difficult problems. The production of milk in villages takes place on a very small scale in numerous scattered holdings, which makes the task of collection difficult. Many villages are not connected by good roads, and many more are inaccessible during the monsoon rains. There are no facilities for cooling or refrigeration of milk on receipt at a village collection centre and rapid transport to a processing centre is hampered by lack of facilities and infrastructure. Under these conditions, procurement of milk of suitable quality in a condition fit for processing into marketable products is a formidable organisational task which has been performed well by many dairy cooperatives on a fairly large scale.

Numerous agencies and persons are involved in the collection, transport and distribution of milk; village producers who directly supply milk to village cooperatives, milk collectors who collect milk from producers and supply to the collection centres of organised dairies or to urban areas or halwais (traditional manufacturers of sweets), milk vendors, dairies who process market milk and milk products, wholesalers and retailers. Milk may be carried to the collection point as headloads, or in containers suspended over shoulder slings, on bicycles, on pack animals, or horse drawn carriages depending upon the quantity of milk to be transported and distances involved. In the case of villages situated at greater distances, the milk collectors or agents may transport milk cans in trucks or by rail for sale directly to consumers or halwais

and to collection centres or private dairies. In some cases, milk is also transported in small boats.

For long distance transport of milk, galvanized iron cans (fabricated locally) or factory made aluminium alloy milk cans are generally employed, and where the collection and transport of milk supplies are organised by milk cooperatives or by large dairies, the cans are cleaned and steamed at the dairy and then returned to the collection centres. Public sector/cooperative dairies have their own milk collection and distribution systems and their major responsibility is that of distribution of pasteurised milk to consumers. These dairies now account for some 25 per cent of all the milk marketed in India. Cooperative milk unions have been organised in several parts of the country and have tackled successfully the twin problems of marketing the rurally produced milk and of supplying good quality milk to the urban population. Presently, some 447 cities in India are served by the organised sector, handling over some 7 million litres of hygienically processed milk per day. They cater for some 55 million customers.

The demand for fluid milk of the four major cities in India (Bombay, Calcutta, Delhi and Madras) is estimated at about 6 million litres per day of which nearly 50 per cent, or 3 million litres per day, is provided by the ten public sector dairy plants in these cities. The remaining 50 per cent of the demand is still being supplied by the traditional milk trade.

Milk produced in large scale organised farms with herds of from 100–1000 head of cattle and buffalo constitutes only a negligible fraction of market milk in India. Some of these farms also have pasteurising plants and cold storage facilities.

Some 10 per cent of the milk produced in India is processed by the organised sector in 250 dairy plants in the cooperative, public and private sectors with a combined throughput of 12 million litres per day.

6.2 HIMALAYAN REGION - NEPAL AND BHUTAN.

Particularly in Nepal and Bhutan, according to the availability of feed, the herds are moved over rough and tough mountains and hills to the new pastures. So it becomes necessary to follow the herds and make the traditional type of milk products en route. The keepers of yak, nak, chauri or cows have to stop in each place. The animal keepers have huts as well as mobile types of housing, such as tents, and other structures built of stones. During the monsoon, the rain, snow and wind penetrate the structures. Farmers have to carry all their equipment with them along with the herds. In the alpine regions of Nepal and Bhutan, yak and chauri herds are migratory in nature and have natural breeding. The milk supply is at its peak in the summer months and decreases in winter to nothing. In the winter season the fodder and feed supply is seldom sufficient. Therefore, the traditional type of milk products are not manufactured in the winter season.

In the mid-hills and valley regions of Nepal and Bhutan, stall feeding and grazing of animals both are practiced in the villages. The processing of milk and milk products is done mainly in the villages where there is no liquid milk demand and supply. Especially in Nepal, cottage type cheese and dahi (yoghurt) are produced. In the rural areas milk is 'boiled', but without knowing any exact temperature of treatment. In the urban areas, modern methods are now used for processing milk and products including cottage cheese.

In Nepal and Bhutan particularly in the alpine regions, sometimes, the milk is boiled at herd level. But in eastern Bhutan, boiling or pasteurisation of milk for the manufacture of traditional milk products is not practised.

In Nepal, the modern technology of milk processing for yoghurt making is undertaken by the Dairy Development Corporation and some private dairies which have modern equipment and

machines.

Table 18. Land and milch animal holdings in India.

Particulars	*Total operational land holding (TOL) groups					All
	1	2	3	4	5	
Number of households surveyed	2,122,278	1,687,210	1,022,370	653,740	501,489	5,987,087
Average household size (No. of persons/household)	4.9	5.2	5.8	6.5	7.5	5.5
Household owning milch animals	769,730	1,052,169	798,960	558,586	444,560	3,624,005
Cross-bred cows	88,295	186,627	117,347	86,860	99,322	578,451
Other cows	449,501	766,606	707,470	554,246	754,633	3,232,456
Upgraded buffaloes	143,735	140,214	149,172	169,579	202,151	804,851
Other buffaloes	708,945	997,855	958,047	839,991	820,727	4,325,565
Total:	1,390,476	2,091,302	1,932,036	1,650,676	1,876,833	8,941,323
Average number of milch animals held by a producer household:						
-Cross-bred cows	0.11	0.18	0.15	0.16	0.22	0.16
-Other cows	0.58	0.73	0.89	0.99	1.70	0.89
-Upgraded buffaloes	0.19	0.13	0.19	0.30	0.45	0.22
-Other buffaloes	0.92	0.95	1.20	1.50	1.85	1.19
Total:	1.80	1.99	2.42	2.96	4.22	2.47

*** TOL 1: Land less, TOL 2: Up to 2.50 acres, TOL 3: 2.51 acres to 5.00 acres, TOL 4: 5.01 acres to 10.00 acres, TOL 5: 10.1 acres and above.**

IV TECHNOLOGY OF MAIN CATEGORIES OF PRODUCTS

Contributors to this review of traditional milk products in southern, eastern and western Africa, the southcone countries of Latin America, the Middle East - Syria, India and neighbouring countries and Nepal and Bhutan, have provided considerable detail on the traditional milk products of their region.

Considerations of the technologies applied in the preparation of traditional milk products are based on groupings within the following categories:-

a. **Fermented milks,**

b. **Butter and ghee,**

c. **Cheeses,**

d. **Other milk-based products,**

Common and specific features will be noted in relation to the products mentioned but details of the processes will be given in Part 2 which summarises the results of the questionnaires sent to more than 100 countries.

1. CONSERVATION OF MILK.

It is evident from the contributions to this review that in most of the countries to which reference is made, that conservation and prevention of the spoilage of milk remain of major importance. The producers of milk in the countries under review have not been influenced to a major extent by improvements in refrigeration and milk collection methods such as have had a major effect on dairying practices, milk conservation and milk quality in the past thirty years in countries with a developed dairy industry.

Methods to protect milk from spoilage remain empirical and yet they appear to offer at least some help to the milk producer.

In reviewing the technologies employed in the preparation of traditional milk products it is necessary to appreciate that the characteristics and quality of the milk produced in the countries concerned is not comparable in bacterial content with the milk from dairy farms in developed dairy countries which are equipped with refrigerated milk coolers and bulk milk collection. Nevertheless, practices for the limiting of spoilage of milk are in place in the countries concerned and include immediate boiling of milk after its production, the use of lactose fermentation by lactic acid bacteria as a means of preventing milk spoilage and sanitising methods which include smoking of the vessels used for milk and milk products.

2. FERMENTED MILK PRODUCTS.

It is mentioned above that fermentation of lactose to form lactic acid is an important means of preventing, or limiting, milk spoilage due to the growth of contaminating bacteria and their enzymic activity.

The value of lactic fermentation as a means of preservation has led to a situation in Africa, the

Middle East, and India and neighbouring countries, that many of the processes for traditional milk products include a fermentation stage. This stage not only affects the shelf-life of the product but it also affects the quality and characteristics of the product.

As an example, the souring of milk leads to the preparation of products such as dahi and other highly soured milks which can either be consumed in liquid form or may be processed further with separation of the milk constituents into traditional butter which is the basis of ghee, and soured milk which may be eaten as it is or be further developed into various cheese products.

This fact is illustrated in the flow chart of the conversion of milk into Indian traditional dairy products - Figure 1. The technologies, or perhaps more correctly the outline methods, for the various fermented milk products are compared below and details of the processes are given in Part 2.

3. LACTIC ACID FERMENTATION.

All of the reports refer to the use of natural fermentation as being the most important means of achieving the necessary souring either in the formation of a fermented milk product ready for consumption or in an acidification or souring intermediate stage in a product's preparation.

4. DESCRIPTION AND OUTLINE METHOD FOR TRADITIONAL MILK PRODUCTS.

It is clear that very many variations in the characteristics, quality and acceptability of traditional milk products are inevitable due to the unregulated nature of natural fermentations which have such an importance. In many cases little is known of the exact nature of the bacteria or other micro-organisms contributing to these fermentation processes.

5. FERMENTED MILKS.

5.1 SOUTHERN AND EASTERN AFRICA - GENERAL.

Southern and eastern Africa encompasses a wide range of climatic conditions ranging from the hot humid coastal areas, dry and semi-arid grass hinterlands (areas of extensive pastoralism) to high altitude highlands with subtropical to temperate type climates. Mean diurnal temperatures may range from as low as 15–17°C in the highland areas to as high as 35°C in semi-arid and arid areas. These high ambient temperatures coupled with the general lack of refrigeration facilities imply that the milk, often containing high initial numbers of bacteria, becomes sour in 12 to 24 hours. It is no wonder that spontaneously fermented milk is the basis of traditional dairy processing at the household level.

Over centuries of cattle keeping, technologies have evolved within different communities resulting in products of varying tastes, colour, texture, consistency and keeping quality. With so many ethnic groups in the region, each with its distinct cultures and preferences, it is virtually impossible to give a detailed description of individual processing techniques.

Those techniques which appear common in the region and might have an influence on any future efforts aimed at transforming traditional household level dairy processing to community level technologies required in the process of commercialisation of dairying are considered.

5.1.1 Fermented milk.

The preparation of fermented milks in Africa has been described previously by Shalo and Hansen (1973), O'Mahony and Peters (1987a and 1987b) and Shalo (1987).

The use of smoking of the vessels used in the storage of the milk by various pastoral and agropastoral communities in the region is, with very few exceptions, the commonest feature. A limited list is given (Table 13) of plant materials including grass, shrubs and hardwoods used

for the smoke treatment of milk utensils by various communities in three countries in southern and eastern Africa.

The general processing method for fermented milks in southern and eastern Africa is to filter the raw milk into a smoked clay pot or bottle gourd and transfer the vessel to a warm place until the milk has soured and coagulated. Fresh batches of milk may be added each day with or without previous removal of whey, until the gourd or clay pot is full. The fermented milk may be consumed as such (straight fermented milk) or as in the majority of cases, it is churned to produce butter. The buttermilk is then consumed at the household level or sold or exchanged for grains (Kerven, 1987).

5.1.2 Concentrated fermented milk.

This traditional product is made among the nomadic pastoral Samburus, the Maasai and agro-pastoralists such as the Nandi, Kipsigis and Tugen of Kenya. The essential difference between this group of products and fermented milks is that whey is removed to increase the total solids in the curd. The processes used in the region have been reviewed by Shalo (1987) and Bekele and Kassaye (1987).

5.2 SOUTHERN AND EASTERN AFRICA - ETHIOPIA

5.2.1 Irgo (fermented milk).

Smoke treatment of milk utensils. Containers of calabash, clay pots, woven grass or plant fibre vessels or hollowed wood vessels are washed with hot water and rinsed with cold water.

The vessels are then smoked by burning chips of Olea africana or Acacia busia. In some areas, the hot smoking chips are introduced into the vessel and whirled inside for a few minutes with

the lid of the vessel on. In other cases, the vessel is inverted over the smoking chips until the smoke dies out.

5.2.2 Hard fermented milk curd.

This product is prepared by the Borana tribes, pastoralists in southern Ethiopia for use during the dry season.

The preparation is similar to that for irgo except that in this case there is daily removal of whey and the addition of fresh milk until the vessel is filled with hard curd.

When milk is soured and reaches an acidity of about 1 per cent lactic acid, fermentation ceases and two layers - curd and whey - are formed.

The curd floats on the whey and the whey is removed by a wooden pipette introduced into the vessel. This type of product may be used for up to 90 days (Bekele and Kassaye, 1987).

5.2.3 Arrera (sour butter milk).

Arrera is a by-product of butter making in Ethiopia. The milk fat content ranges from 1 per cent to 3 per cent depending upon churning temperature. It is rich in protein, lactose, minerals and vitamins. It makes a wholesome beverage either plain or spiced in the same way as irgo.

When there is a plentiful supply of fresh whole milk, this product is given to calves, lactating cows and dogs. Alternatively it may be converted into local cheese.

5.3 WEST AFRICA - MALI.

5.3.1 Kadam (fermented milk).

This is a traditional beverage amongst producers and consumers especially as a thirst quenching drink in the hot season. Residual milk is accumulated and allowed to sour. Depending on the season the souring may take a few hours or several days.

5.3.2 Sour butter milk.

After the butter is removed from soured milk which has been churned to produce butter, the buttermilk is consumed by the family or sold.

In urban centres, the suburbs of towns and the city of Bamoko, the milk traders produce butter and buttermilk.

5.4 SOUTHCONE COUNTRIES OF LATIN AMERICA.

5.4.1 Yoghurt.

This fermented milk is made in a traditional way in some southcone countries of Latin America such as Paraquay.

5.5 MIDDLE EAST - SYRIA

5.5.1 Laban.

(i) Small-scale production at the village level. There are two procedures which are used:-

a. **the raw milk of the cow, sheep or goat is placed in a tin or copper container and immediately innoculated with a starter of lactic acid bacteria or with a small amount of a**

previous batch of laban.

b. Alternatively the farmers heat the milk to about 80°C and then cool it to around 37–40°C and then add either a starter or 5 per cent of a previous batch of laban.

In each case, thereafter, the containers of inoculated milk are covered with woollen sheets to keep the temperature constant for not less than 4 hours.

Some local types of laban have a burnt taste and a cooked smell which are due to processing methods.

After souring the laban is cooled until used.

Garlic is sometimes added to laban along with pieces of ice to make a refreshing summer drink called airan.

(ii) Large scale production in Government factories.

Milk is collected from production centres and smallholders and sampled for quality analysis.

5.5.2 Labaneh (laban mousafa).

This may be described as a drained laban or drained yoghurt. The product combines the characteristics of laban and cheese. The dry matter content is estimated as 18–23 per cent i.e. higher than in laban and lower than in cheese. The pH ranges from 5 to 5.5. It is very popular in Syria as a breakfast dish, especially if olive oil is added.

5.5.3 Shenineh.

This product is prepared by shaking laban in a special bag made of sheep skin. It has a sour taste and a very strong aroma and is very popular in the villages.

5.5.4 Shenglish (Sorke).

It is made from laban and is considered as a fermented milk but the dry matter is very much higher (45–50 per cent). Spices are added to give it its special taste and chilli may also be added.

5.5.5 Keshkeh.

This product is made by mixing laban with fine wheat. The mixture is dried and ground into a powder.

5.6 INDIA AND NEIGHBOURING COUNTRIES

5.6.1 Dahi.

This milk product is of major importance in the Indian sub-continent. It is a yoghurt-like product made in India and neighbouring countries. It is the most important fermented milk product used in India from times immemorial. The scale of production ranges from household level to industrial scale including preparation in halwai's milk shops in urban areas. Cow or buffalo milk or a mixture of the two is used. It is boiled and sometimes concentrated before addition of the starter which is usually a portion of the previous day's dahi or buttermilk.

Dahi has a milk pleasant flavour and a clean acid taste. It has a yellowish creamy-white colour when made from cow milk and a creamy-white colour when made from buffalo milk. It has a smooth and glossy surface. The body is firm but not hard and free from gas holes.

The Bureau of Indian Standards has laid down the following specifications for dahi:-

	Sweet dahi	Sour dahi
Acidity (per cent (w/w) lactic acid) (maximum)	0.7	1.0
Yeast and mould count per g (maximum)	100	100
Coliform count per g (maximum)	10	10
Phosphatase test	-ve	-ve

Dahi is widely consumed all over India and the neighbouring countries including the Himalayan region, either plain, sugared or salted. The sweetened concentrated form of dahi consumed in Bengal is known as mishti doi i.e. sweet dahi.

5.6.2 Mishti Doi.

A sweetened variety of dahi known as mishti doi, mishti dahi, lal dahi (red dahi) or payodhi in the eastern region of the Indian sub-continent is very popular.

Cane sugar (6.0 – 6.5%) is added to the milk before boiling. Artificial colour, caramel and jaggery may also be added. The milk is cooled to 40–45°C and incubated for 12 – 15 hours.

5.6.3 Lassi.

Dahi is converted into this refreshing beverage by stirring and adding a small quantity of water. It is best consumed chilled, and either sweetened or salted.

It is a preferred drink in the northern parts of the sub-continent particularly the Punjab and Haryana. It is known to induce sleep particularly after consumption during the summer afternoons. Aseptically packed long life lassi has recently been introduced in India.

5.6.4 Shrikhand.

Shrikhand or Sikarni, as it is known in Nepal, is made from concentrated dahi with a sweet and sour taste. It is a semi-soft whole milk product resembling sweetened quarg or quark produced in Germany. Shrikhand is traditionally made at home in western India. The name shrikhand is derived from the Sanskrit work shikharini.

Dahi is placed in a muslin cloth and drained for 4–8 hours to reduce the whey content and produce a solid mass called chakka or maska.

Chakka is mixed with the required amount of sugar, condiments and flavour to produce shrikhand. An industrial process for the manufacture of chakka and shrikhand has been developed by the National Dairy Development Board of India.

The Bureau of Indian Standards has prescribed the following standards for shrikhand.

Total solids (per cent by mass) (minimum)	58.0
Milk fat (in dry matter per cent) by mass (minimum)	5.0
Milk protein (in dry matter per cent) by mass (minimum)	10.5
Titratable acidity (per cent lactic acid) (maximum)	1.4
Sucrose (in dry matter per cent) by mass (maximum)	72.5
Total ash (in dry matter) per cent by mass (maximum)	0.9
Coliform count, per g (maximum)	10.0

Yeast and mould count, per g (maximum) 50.0

5.6.4 Shrikhand Wadi.

This product is obtained by further concentration of shrikhand as prepared above by heating in an open pan over a direct fire until it forms a hard mass.

Shrikhand wadi has the following composition.

	(per cent)
Moisture	5–6
Fat	7–8
Protein	8–10
Lactose	15–17
Ash	0.75–0.80
Sugar	63–65
Lactic acid	1.0–1.2

5.6.6 Chhaas (Buttermilk).

Buttermilk produced by the churning of soured milk (dahi) is known as chhaas or chhach and as mahi in Nepal. The fat content is usually from 1–2 per cent and it is rich in protein and lactose.

Chhaas is mostly consumed in the household and surplus is fed to cattle.

5.6.7 Kadhi.

This product is made from chhaas by a recipe which varies from region to region.

A blend of spices, of which the common ingredients are salt, black pepper, green chillies, turmeric, coconut, and ground cumin are added with a small amount of Bengal gram flour to an appropriate quantity of chhaas and the mixture is brought to boiling point. It is then served hot with rice.

In some regions of the country, small balls made out of besan (Bengal gram flour) dough and fried in oil are added to kadhi and served as a curry.

5.7 HIMALAYAN REGION - NEPAL AND BHUTAN

5.7.1 Dahi Production in Nepal.

The techniques for Dahi production in Nepal are largely similar to those used in India and details are given in Part 2.

5.7.2 Mahi.

This is a traditional drink in Nepal. It is made from dahi prepared from whole or skimmed milk dahi fermented either by natural souring or by 'artificial' lactic acid bacteria.

In India, mahi is known as lassi and largely used as a liquid drink. In Nepal, mahi is consumed as a drink as well as with food.

When whole milk dahi is churned by traditional country methods, the butter yield is not the theoretical possible. The fat globules are not in a proper condition for churning and they are in the liquid form and not in the clumped semi-solid form always found in conditioned cream. The

traditional country churning process has the effect of homogenising some of the fat globules and these broken-up globules do not appear in the butter and neither do the smaller fat globules of the milk.

Therefore the mahi buttermilk is richer in fat, due to high fat losses in churning. The fat in skimmed milk dahi is only that which is lost in the skimming or separating process i.e. around 0.05 to 0.1 per cent if properly done. In the case of buttermilk mahi or lassi the milk fat content may reach 1 per cent.

When the fat is churned out of whole milk dahi the remaining acid buttermilk is a more correct example of traditional buttermilk than a product made by the lactic acid fermentation of skimmed milk. Mahi prepared from soured skimmed milk is a poor beverage compared with that made from the buttermilk of whole milk dahi.

Mahi or lassi may be sweetened by the addition of sugar. The drink may also be made by diluting dahi with about five times its volume of water.

Dahi sherbet can be made by diluting dahi with 8 to 10 times its volume of water containing 8 to 10 per cent of sugar and lemon juice.

6. BUTTER AND GHEE AND RELATED PRODUCTS.

Throughout southern and eastern Africa, the Middle East - Syria and India and neighbouring countries the production of butter and ghee is closely associated with the technology of fermentedmilk.

This is because most of the traditional butter is made by churning fully soured whole milk which could also be used for consumption as a whole milk fermented drink. In these regions

traditional butter is not made by churning cream.

With the exception of some industrial dairy factories ghee is made from traditional butter. The main variations of buttermaking lie in the appliances used for churning the soured milk. These will be described later in relation to their area of use.

6.1 BUTTER MAKING.

6.1.1 SOUTHERN AND EASTERN AFRICA - GENERAL.

6.1.1.1 General Method for Butter.

Throughout southern and eastern Africa, traditional butter making involves the churning of sour milk in a variety of vessels, the most important being the gourd, clay pots, and wooden vessels carved out of some tree trunks. Bekele and Kassaye (1987) described some vessels used by Borana pastoralists in southern Ethiopia and details of these are given under the individual process descriptions. Churning is usually done by women and consists of rocking the vessel (gourds), or clay pots, which are suspended from a wooden post, or tripod, or placed on the ground or the woman's lap back andforth until butter granules form. The buttermilk is drained off by pouring it through a rough filter of specially treated fibres of tree bark or washed grass and is usually consumed by the household.

6.1.2 SOUTHERN AND EASTERN AFRICA - ETHIOPIA.

6.1.2.1 Kibe.

This traditional butter is made by churning sour milk.

The churn is made of the same materials as the vessel for souring milk, except for the addition of the skin bag, which is used by the Afar pastoralists in the rift valley. In some cases,

especially in the highlands, the sour milk is churned in a different vessel from that in which souring is done. Washing and smoking practices are as described earlier.

The technique of churning differs from region to region depending upon the size and make of the churn.

6.1.3 WEST AFRICA - MALI.

6.1.3.1 Nebam.

Nebam is the local name for traditional butter in Mali. The used churn has a large round body and a narrow neck ending in a funnel-shaped mouth. There are different sizes of gourd churns depending on the volume of milk available for churning. Normally it has about 5 litres capacity.

The woman sits on a mat and churns the milk by raising and bouncing the gourd either on her lap or on a small cushion. When the butter granules are formed, the contents of the churn are poured out into a calabash bowl (tumde). Cold water is added to the bowl to harden the butter granules which are then scooped out of the buttermilk and subjected to the final working or kneading stage.

6.1.4 SOUTHCONE COUNTRIES OF LATIN AMERICA.

6.1.4.1 Farm Butter.

Farm butter is produced in Peru and other southcone countries of Latin America.

6.1.5 MIDDLE EAST - SYRIA.

6.1.5.1 Zobdeh.

Production of zobdeh (butter) in Syria takes place at the village level and in government dairy

factories.

Village-level butter making is based on the heating of milk from the cow, sheep or goat and the collection of the cream (koshtah) which forms on the surface as the milk boils. When cold the cream is churned by shaking it in a sac made of sheepskin or goatskin or other special container until butter granules are formed.

Butter production at factory processing level may be based on whole milk or cream (koshtah) but usually on cream. Standard industrial procedures are used for churning and packaging and the product is stored at 5°C.

6.1.6 INDIA AND NEIGHBOURING COUNTRIES.

6.1.6.1 Makkhan.

Makkhan is the traditional unsalted butter made by hand churning whole milk dahi. Beginning from the vedic times (3000 to 2000 BC) there is recorded evidence to show that makkhan was extensively used by the early inhabitants of India; both in dietary and religious practices. The milk of the water buffalo, by virture of its higher fat content and larger fat globules gives higher yields and is preferred. White makkhan from buffalo milk is generally preferred to the yellower product from cow milk.

About 170,000 metric tons are estimated to be produced annually in Indian households.

Outline of Method (Small Scale Units)

Whole milk is used

The milk is converted into dahi - the milk

being set in an earthenware pot.

Churning is done with indigenous wooden churning devices at ambient temperatures

The cooler morning hours are preferred for churning.

The product made from buffalo milk has a harder/firmer body and a more granular texture than that from cow milk. It has a pleasant mild acid flavour.

The makkhan formed in the churn is hand scooped or removed with a wooden ladle or perforated scoop.

Legal regulations in India require that makkhan contains not less than 76 per cent milk fat by weight.

The average composition is as follows.

	(per cent)
Moisture	18–20
Milk fat	78–81
Curd	1.0–1.5
Lactic acid	not more than 0.2

Makkhan is used in small quantities for direct consumption with the traditional unleavened bread (chapati or parontha) or boiled rice and other items of food. Household surplus of makkhan is used mainly for conversion into ghee. Organised dairies, produce butter on a commercial scale using modern butter making machines. Only a part of the butter produced in India is used as table butter and a large portion is used for the production of ghee on a

commercial scale. Ghee made from makkhan has a firmer consistency, better crystalline texture and reputedly a better shelf-life than the product made in factories. Whenever boiling of milk is carried out over a smoky fire, the makkhan produced from milk heated in these conditions has a typical smoky flavour which is often preferred by a section of the consumers, particularly in the northern region.

6.1.7 HIMALAYAN AREA - NEPAL AND BHUTAN.

6.1.7.1 Nauni Ghiu (Nepal), Ma (Bhutan).

Traditional butter, Nauni ghiu and ma, is produced in the alpine regions of Nepal and Bhutan in yak, nak or chaury herds. It is made from whole milk which has been naturally soured. Cream is not used as the basis for traditional butter in the Himalayan area. Coagulated and acidified milk churns into butter more rapidly than sweet milk owing to the lower viscosity of its serum. It is also believed that the ghee made from butter churned from soured whole milk has the best flavour. In Nepal the butter churn made of raw wood and used in yak herd areas is known as a tolum. It is a cylindrical wooden churn of about 20–30 litres capacity. No salt is added. The water content may be around 25 per cent. In traditional butter making from soured whole milk the fat losses to the buttermilk are higher in hot weather, therefore higher yields of butter are obtained in cold weather.

6.1.7.2 Butter Salt Tea.

In the alpine regions of Nepal and Bhutan, the butter produced by traditional methods is also used for making butter salt tea. The wooden churn of cylindrical shape has a manual piston type stirrer made of wood or bamboo. It is known as a chyadum. Tibetan tea is churned with hot water, butter and salt. After churning, the butter salt tea is poured into a kettle and kept near a fire so that it is ready to be offered in cups. This type of tea drinking is very common in

Tibet, Bhutan and the alpine region of Nepal.

6.1.7.3 Production of Ghee.

Ghee is a very important traditional milk product in Africa, the Middle East and India and neighbouring countries including those of the Himalayan area.

Its main use is for frying of food and its main advantage over butter from which it is traditionally prepared is its superior keeping quality derived from the almost complete removal of water during the making process. The boiling process drives off moisture and reduces the water content to well below one per cent so effectively preventing microbial growth. At the same time the boiling process destroys spoilage bacteria, all pathogens and inactivates some of the enzymes resulting from bacterial growth in the milk and butter.

The production of ghee is practised at household, village and industrial level in some countries.

For example in India ninety per cent of the ghee is produced by the traditional method of making unsalted butter (makkhan) first and then converting it into ghee. About 650,000 metric tons of ghee are produced in India annually.

6.2 METHODS FOR THE PREPARATION OF GHEE IN INDIA.

Ghee originated in India long before recorded history. The name has its origin in the Sanskrit word meaning ‘bright’. The Vedas contain many references to ghee. About 650,000 metric tons of ghee are produced in India per annum of which 90 per cent is produced by the traditional method of making makkan and then converting it into ghee.

Makkhan (traditional unsalted butter made by hand churning whole milk dahi at room temperature) is placed in a metal vessel and heated to about 110 to 120°C with constant stirring over a low fire to evaporate the moisture. When practically all the moisture has been removed, further heating is avoided by removing the vessel from the fire. After the residue has settled down on cooling, the clear fat is decanted into suitable containers. At factory-scale modern processing equipment is used. Ghee is made either (i) from creamery butter or (ii) directly from cream.

i. **Unsalted creamery butter (commonly known as white butter) is heated in a ghee boiler which consists of a stainless steel jacketed pan provided with a manual stirrer. The pan has an outlet in the bottom for emptying the content as required. Butter is first melted at low heat and then the steam pressure in the jacket is increased so that the mass begins to boil. The contents are constantly agitated throughout the process to prevent scorching. Usually there is profuse effervescence accompanied by a crackling sound in the early stages of boiling which decreases as the moisture evaporates. When practically all the moisture has been removed the temperature of the liquid mass suddenly shoots up and the heating at this time has to be carefully controlled. The end point is indicated by the appearance of a second effervescence, which is much finer than the first, together with the browning of the curd particles. At this stage the characteristic ghee flavour develops.**

   The final temperature of heating generally ranges from 110 to 120°C depending upon the practices in different regions. In some parts of India it is heated to higher temperatures resulting in a burnt or overcooked flavour which is relished in those parts.

   After cooling and sedimentation the ghee is filtered through a muslin cloth to remove the sediment known as 'ghee residue' which consists mostly of burnt co-precipitates.

The product acquires the characteristic granular texture on cooling and is generally packed in tin containers, glass bottles and plastic pouches.

ii. **Cream is heated in a ghee boiler as described above. The procedure of heating and moisture removal, final temperature of clarification, cooling and sediment removal and granulation also remain the same. The direct cream method yields a higher quantity of ghee residue and takes a longer time. However, a method where plastic cream is directly heated and converted to ghee has been used and resulted in higher yields. The cream may be washed to reduce the content of solids-not-fat. This reduces the ghee residue, thereby increasing the yield of ghee.**

The colour of cow ghee is deep yellow while that from buffalo milk is white with a characteristic yellowish or greenish tinge. It has a pleasant cooked and rich flavour. The taste is usually characteristic of the milk fat; slightly acidic flavours are sometimes preferred.

Typical ghee has the following composition:-

	Cow	Buffalo
Milk fat (per cent)	99–99.5	99–99.5
Moisture (per cent)	0.2–0.5	0.2–0.5
Unsaponifiable matter		
(a) carotene (mg/g)	3.2–7.4	-
(b) vitamin A (IU/g)	19–34	17–38
(c) tocopherol (mg/g)	26–48	18–37
Free fatty acids		

(per cent oleic)	1–3	1–3

Ghee should meet the following legal requirements in India:-

butyro refractometer reading at 4°C 40–45 (depending on the region) R.M. value (minimum) 21–28 (depending on the region) FFA per cent (as oleic acid) (maximum) 3.0 Moisture, per cent, (maximum) 0.5

In India and Nepal under existing trade practices, grading of ghee is carried out to a limited extent at different places and stages of collection by rule-of-thumb methods. Grading requires testing of the product immediately before packing and sealing. Grading assures the customers of the quality and purity of the product.

In India grading of ghee has been made through the Agmark Ghee Grading Scheme initiated by the Government of India in 1938. There are the following standards for Agmark ghee:-

Moisture (maximum) 3 per cent, free fatty acids (as oleic acid) not more than 1.4 for special quality and not more than 2.5 for general quality.

A ghee refinery may submit an application to the appropriate authorities for the issue of a certificate of authorisation for the grading of ghee. After an authorised certificate is obtained, the product is given the Agmark stamp of quality.

The methods used for ghee preparation in other countries are summarised in Table 19.

6.3 MALAI (BALAI).

Malai (Balai) is the firm skin that forms on cooling boiled milk. The yield of malai depends on the type of milk and the temperatures to which it is boiled. It is not generally sold through

markets or halwai shops.

This product is made at home by skimming off the firm skin from the cooled boiled milk and melting it into ghee.

To meet Indian legal requirements, malai should contain a minimum of 25 per cent milk fat.

Table 19. A comparison of ghee production in several countries

	Southern and eastern Africa General	Southern and eastern Africa Ethiopia	West Africa-Mali	Middle East-Syria	Nepal and Bhutan
Local name(s) of product	Varies with the country	Nigour kibe (melted butter) Nitir kibe (butteroil or spiced ghee)	Sirme (ghee)	Samneh (butteroil or ghee)	Ghee orghyu (clarified butter fat)
Introductory	Production of butter and thereafter ghee is closely associated with the local methods for preparing fermented milk which has been soured	Traditionally butter (kibe) is made by churning sour milk which has fermented in a container which may be calabash, clay pot, grass or woven plant fibre, or a hollowed wooden vessel for 3–5 days. The vessel used is	Butter which has been churned - normally using a bottle gourd of around 5 litres capacity -	All butter and ghee produced in Syria is made from sheep or cow milk but the price of sheep milk ghee is higher than that from cow milk.	Traditional ghee orghyu in Nepal is used almost universally as a shortener of pastries, as a frying medium and as an

	over several days.	subjected to smoking treatment before use.	from soured whole milk is the starting point.		ingredient of cooked products. It contributes greatly to the calorific value of foods. It is also used in religious festivals and functions.
Outline method	Butter produced by churning fermented milk in gourds is placed in a saucepan. pot or other suitable container. The container with the butter is placed on a traditional wood-fired	Butter resulting from churning of the soured milk is the basis of two products:- (a) Nigour kibe (melted butter) which is prepared by heating fresh butter in a saucepan to about 40°C on a slow fire. During the heating. bishop's weed. and cardamon seeds are added to the butter.	Fresh butter (nebam) is placed in a calabash bowl and kneaded with the convex part of the calabash ladle to remove excess butter milk.	At the village level butter is made from cream normally called koshtah. The cow milk is boiled and since the fat is lighter than the serum the cream layer slowly forms at the surface and is taken off continuously.	Ghee may be made direct from cream but this is not considered as a traditional method. The traditional method is based on processing of butter

	cookstove with a slow fire to boil off the moisture in the butter.		The butter is then transferred to a metal saucepan and placed over the fire.		which has been produced by churning dahi produced from cow or buffalo milk.
	There are 2 variations in the method:- (a) The ghee is prepared by simply heating the butter until it is ready as judged by colour - light brown for the ghee residue and straw yellow for the melted	This product is made to lengthen the shelf life of fresh butter. It is an intermediate between butter and ghee and contains about 10 per cent moisture. It can be kept at normal room temperature for about 6 months without developing noticeable rancidity.	Water is driven off during the heating process and the process of ghee making is either stopped before the yellowish clear	The cream is shaken in a special container or in a sac made of sheepskin or goatskin until butter is formed. Butter is placed in tin or copper containers and heated to around 100°C to drive off the water.	The acidity consistency and quality of the dahi is affected by the ambient temperature. Butter prepared by churning the dahi is not drained completely and may contain 25 to 35 per cent of water.

butterfat. The molten butterfat is decanted and is then termed ghee.		product is obtained or continued till the process is completed.		The preparation of ghee involves the evaporation of the moisture from the butter by heating it in a container over a fire until all the water has been removed. The molten butterfat is then recovered. Normal yield is around 1 kg of ghee from 20 kg milk.
(b) Cereal flour or left- overs of the traditional hard porridge is added during the heating to assist in the clarification of the ghee. The non-fat milk solids of the butter precipitate together with the added cereals to form a nutritious and	(b) Nitir kibe is spiced ghee and is used for cooking For its preparation either kibe (traditional butter) or nigour kibe is inspected and cleaned of any visible impurities and placed in a saucepan over a fire. When the butter is melted, powdered spices, composed of fenugreek, black cumin, bishop's weed, cardamon, long pepper, ginger, sacred basil, black pepper, turmeric, rue and garlic are added	The partially boiled product and the final product are either consumed by the maker and his family or sold in the local market.	Ground wheat is added to the boiling butter to absorb the remaining water and to reduce the boiling period. After the boiling foam has disappeared the hot ghee is filtered through wire mesh sieve and poured into clay pots which are stored in the	Various

delicious by-product which is usually given to children as an occasional meal

This practice is widespread around Lake Victoria in Tanzania, the Kamba in Kenya and with the Ethiopian Borana.

either directly or enclosed in a small cloth bag.

The mixture is then heated to about 80°C or until a clear yellowish liquid is obtained. The pan is then removed from the source of heat and

dark.

On an industrial scale in government factories, butter is the main material for ghee production. The freshly-made butter is taken from the churns and placed in the boiling vats where

agencies including the producers, village merchants, middlemen traders and wholesale merchants are involved in the collection and distribution of traditional ghee.

		allowed to cool. During cooling, the non-fat milk solids and the spices settle to the bottom and the yellowish fat layer is decanted and filtered through a clean cloth into a clean container.	it is heated and the water content is reduced to around 0.2 per cent. The fat content after the heating or boiling stage is completed is 99.5 per cent and there is 0.3 per cent of milk protein and other solids.	
		The vessel for storing nitir kibe is calabash, a clay pot or a large cattle horn. This product is kept in a cool place within the house and when required a portion is removed from the container using a horn spoon.	The final product is packed in 2–17 kg cans.	
Quality characteristics	The flavour of the ghee varies	The product keeps for more than 6 months at	Ghee produced in the village-level	In the Himalayan

from place to place depending on the age of the butter from which it was made, for instance, the Maasai people preter ghee made from slightly rancid butter.	normal room temperature.	operations has a different flavour and aroma from that produced in the government's factories due to differences in the acidity and quality of the milk and cream.	area the quality of the butter is mostly acidic, rancid and stale. Rancid butter may give rancid ghee. Some quality grading of ghee takes place under existing trade practices.

7. CHEESE AND CHEESE PRODUCTS.

7.1 SOUTHERN AND EASTERN AFRICA

7.1.1 GENERAL.

Within the countries of southern and eastern Africa there does not appear to be any community which has traditionally made cheese from milk by precipitating the casein by coagulating enzymes.

In Zimbabwe it is reported that the Shona people had the tradition of heating colostral milk in the belief that the cow would subsequently give a lot more milk. Due to the high albumin proteins in the colostrum, the milk readily coagulates on heating and the precipitated curd was eaten by the children. Except in a few cases, the practice has now disappeared.

In Tanzania, interview has revealed that cheese-like products are never made. However, in the Chagga, a mixed farming community on the slopes of Mount Kilimanjaro, some families filter the whey from soured milk in a piece of cloth which is then hung over the fire place in the kitchen for about one week before being consumed.

7.1.2 Sudan - Gibna Bayda.

A considerable amount of cheese is made in Sudan. According to Osman (1987) a pickled type of cheese called gibna bayda is made. It is reported that this type of white cheese was introduced to Sudan by early Greek immigrants. Today the cheese is made by merchants particularly in Ed Dueim (200 km south of Khartoum) during July to September and El Obeid (350 km south-west of Khartoum) during July to January when there are appreciable amounts of surplus milk produced by the local nomadic pastoralists. In 1983, about 500 tons of gibna bayda was produced in the Ed Dueim area above (Osman, 1987).

The cheese resembles feta in appearance, texture and flavour. Mature gibna bayda has a pH of 3.5 to 4.2, a salt concentration of 8–12 per cent which is usually added to the milk prior to precipitation of the casein with rennet, and a moisture content of 55–63 per cent.

Milk of the cow, goat or sheep or a mixture of any two of them may be used for gibna bayda. Osman (1987) gives a detailed description of the processing methods.

The Sudanese experience is an example of adaptation of a foreign product which is suitable for the local conditions and has now established itself successfully in the traditional livestock products systems.

7.2 SOUTHERN AND EASTERN AFRICA - ETHIOPIA

7.2.1 Ayib.

For the production of this local cheese sour milk or buttermilk is heated in a clay pot on a low fire to about 40°C. When the curd and whey separate, the heating is stopped and the contents of the pot are allowed to cool.

When milk is cold, straw or fibre from false banana is introduced in the milk pot to serve as a sieve.

The whey is drained off and the cheese curd is kept in a clean bowl or pot. Because of the high moisture content the product has a short-shelf life of about one week. The keeping quality can be improved by pasteurizing the curd to at least 75°C with accompanying removal of as much whey as possible.

O'Mahony and Peters (1987a) have reported that 8 litres of buttermilk produce 1 kg of ayib with

a composition of 79.5 per cent water, 14.7 per cent protein, 1.8 per cent fat and 0.9 per cent ash.

Ayib is a crumbly product which is eaten with chicken sauce (dorowot), which is considered a national dish, and injera (flat, thin pancake-like bread made from fermented cereal dough). It is also mixed with cooked and minced cabbage leaves, fresh and melted butter and spiced chilli-powder and served along with minced raw meat (kitfo) to be eaten with a spoon. This preparation is frequently eaten with thick flat bread made from false banana flour (kocho).

WESTERN AFRICA - MALI

There is no report of important traditional cheese-like products in Mali.

7.3 SOUTHCONE COUNTRIES OF LATIN AMERICA

7.3.1 Traditional Cheesemaking.

Cheese is the main traditional dairy product made in small processing units in Latin America. It is normally made in very simple and unhygienic conditions mainly from cow milk but from goat milk as well (Chile, Peru and Bolivia).

There are several types of farm cheeses but they mainly belong to the fresh and semi-hard group of cheese, the latter types having a very short period of ripening of 10–30 days and many regional names.

Traditionally farm cheeses are made from raw milk (normally poor milk quality) and the equipment and other facilities to process it are the minimum necessary.

The method of preparation consists of very few processing stages mainly do it in a convenient way and always without standardization of the product. The method of preparation differs from one geographical zone to another and even from one processing unit to another. Farm cheese making is completely dependent on natural conditions, milk quality, environmental conditions (temperatures), workers skill, etc.. Consequently a very variable end product is obtained, without precise identification and with clear deficiencies sometimes in appearance and other sensorial attributes but mainly in basic microbiological requirements.

In spite of this, local people prefer those products instead of the industrial ones because they are considered natural products with very pleasant sensory characteristics. Very important characteristics are flavour, texture and consistent attributes of the cheese. Even more importantly due to the consumers' traditional habits, farm cheeses sometimes have a higher price than similar industrial ones.

Consequently, this is one of the main reasons why some farmers prefer to make and sell dairy products instead of selling the milk for use by the industrial sector. Farm cheese is particularly important in Chile, Peru, Paraguay, Bolivia and Brazil.

7.3.2 Traditional Cheese Varieties Made in Southcone Countries of Latin America.

7.3.3 Chile.

Farm chanco cheese and quesillo or fresh cheese are the typical Chilean cheeses made in small and medium sized dairies in a traditional way and from the 1950s both are processed in the industrial dairy factories as well but with technical methods, and good sanitary conditions, resulting in very standardized products. Goat cheese is another typical Chilean cheese but made only in the small processing units in a traditional simple way.

7.3.3.1 Farm Chanco.

Farm chanco is the main traditional Chilean cheese. Around 130 million litres of milk were used for farm chanco in 1985, in authorised processing units. There are no statistics concerning farm cheese production in non-authorised units, of which there are many. In the same year, the total milk used in the industrial sector for all cheese varieties was 137.8 million litres. This means that almost half of the cheese consumption of Chile is accounted for by this traditional product.

Raw full fat milk is used for farm chanco. The milk may be standardised to 3.0 to 3.2 per cent. Fermentation is by naturally- occurring lactic acid bacteria. Acid production is variable. Calf rennet, bovine rennet or microbial rennet may be used at a rate of 3.09 powder per 100 litres of milk. In some remote cheesemaking units (e.g. Palena, X1 Region) small pieces of calf stomach are used as coagulant, sometimes in a whey solution. Coagulation time islong (up to 1 h) because the temperature is not controlled.

Ripening takes 10–18 days at ambient temperature. There is no environmental control and surface mould growth is common. The composition of chanco cheese is:

	Per cent
Moisture	45–47
Fat	26–28
Salt	1.2–1.8
pH	5.25–5.60

Farm chanco is a semi-hard cheese of Chile. It is a washed-curd type. Its shape is normally rectangular, 30 × 25 × 12 cm and 8–10 kg in weight. The cheese is yellowish inside and on the

surface. No colouring is added to the milk. Irregular eyes are a characteristic of the cheese which has a soft body, and is very smooth.

On average it takes 10–11 litres of milk to produce 1 kg of cheese but yield should be around 8.5–9 litres per 1 kg of cheese if good curd handling techniques are used.

7.3.3.2 Quesillo.

Farm quesillo is an unripened Chilean cheese of very fresh flavour and soft consistency. The correct procedure does not include any fermentation of the lactose. The pH of the cheese should be similar to that of the milk because consumers prefer a non-acidic quesillo. It is made from raw milk on farms. The volume of milk used for this cheese at farm processing units is unknown as this product is mainly prepared at very small units or even in small farms. In general these processing units do not have legal authorisation for cheese production. Most of them produce cheese only in spring and summertime. The cheese is sold at the open markets and offered to tourists on the main roads during the time of summer holidays.

Industrial quesillo is made using pasteurized milk. In 1987 around 30.154 million litres of milk were made into 6,030.8 metric tons of industrial type quesillo which is handled and sold under refrigerated conditions and normally has a shelf life of only 5 days.

The cheese is sold immediately after production. It has no ripening time. The shelf life is only from 2–4 days depending on ambient temperature and humidity. Acid production resulting from poor quality milk causes flavour defects and wheying off and result in poor quality cheese.

Composition of Quesillo

(per cent)

Moisture	65
Fat	12
Salt	0.6–1.0
pH	similar to that of raw milk

The cheese should be soft. Normally the shape is round, about 16 cm diameter, 4–5 cm depth weighing 400 to 600 g. The yield of farm quesillo is not accurately established but on a factory scale the yield is 1 kg of cheese from 5 litres of pasteurised milk.

7.3.3.3 Farm Goat Cheese.

Farm goat cheese is a very typical Chilean cheese made only in the northern region (region IV La Serena) using very simple facilities. Only two or three goat cheese producing units are authorised by the Chilean Health Ministry. However, there is a great quantity of goat cheese produced and sold through illegal middlemen in other regions such as Santiago, II or III Regions, particularly during summer time. In Chile some 10 million litres of goat milk are produced and most of it is made into cheese.

Hygienic conditions for processing do not exist. Goat keepers with their families walk with the goats from the valleys to the Andes mountains looking for feeding for their animals and transforming the milk into cheese while they are going and returning from the mountains.

The farmers and animals do not get enough water for even their own consumption so that the cheese is made under very primitive conditions. It is no surprise therefore that the main food-borne diseases (in general there are few and incomplete statistics) are caused by consumption of goat milk cheese. As a consequence, people hesitate to consume goat cheese, especially people from regions far away from the producing area.

This situation leads to an over supply of goat cheese in the peak producing seasons with consequent financial losses for the cheese producers.

Chilean goat cheese is prepared by a very simple method similar to that for quesillo but since the goat cheese is firmer and contains only around 48 per cent of water there is a pressing stage at the end of the process. Hand pressing of the cheese curd mass is followed by pressing in an artesanal press with weights to achieve the required firmness and removal of whey. Natural ripening of the cheese takes place during the transportation to the valley.

Generally the end product is of poor microbiological quality and contains many pathogens. The product is almost always outside the specific standards of the Chilean Food Sanitary Rulings.

7.3.4 Peru.

Several traditional cheeses are made in small units in Peru.

7.3.4.1 Queso fresco (fresh cheese).

This is the most well known and popular type and is mainly consumed in typical dishes.

7.3.4.2 Queso paria (Paria cheese).

This cheese originated in the Arequipa zone. In olden times it was made from sheep and goat milk but now it is only made from cow milk.

7.3.4.3 Serrano.

A smoked cheese made by traditional methods in the Arequipa zone.

7.3.4.4 Quesillo.

Very simple methods are used to make this fresh cheese in farm processing units in Moquehua and Tacna.

7.3.4.5 Cuajada.

This fresh curd from Peru's north zone is a typical product which is sold as a raw material for processed cheese. It spoils rapidly.

7.3.4.6 Queso Andino (Andean cheese).

During the last decades the National Cheesemaker project has introduced queso Andino which is a demi-hard type with a short ripening period of 2–4 weeks.

In the case of queso Andino the fermentation is mainly produced by the added lactic acid bacteria starter culture. This cheese is very similar to Chilean chanco cheese. Eight litres of whole milk are required for 1 kg of cheese.

7.3.4.7 Goat Cheese.

This is another typical Peruvian cheese produced by farmers. The conditions are frequently unhygienic and the cheese is of variable shape and composition. The yield is very low since a large part of the protein is lost in the whey.

Cheeses are sold to middlemen who determine the price according to the taste, but it is reduced in the summer season due to the fact that the urban population hesitates to eat goat cheese as it is highly contaminated.

Studies are taking place to consider gathering together the small producers of goat cheese and to improve cheese quality and marketing of the products.

7.3.5 Paraguay

7.3.5.1 Requeson dietetico (diet fresh curd).

Farm cheese (criollos) of this variety are made from raw milk but in small processing units the cheese is made from heat treated milk. It is a soft cheese with 48–58 per cent moisture. Rennet enzyme, either from supply laboratories or of natural origin, is used and natural fermentation is normal.

The cheese is mainly consumed at lunch and dinner meals by adding it to soup.

7.3.6 Bolivia

7.3.6.1 Queso criollo (farm cheese).

This is a low fat cheese produced in the Mennonitas communities. Most of this traditional cheese made in Bolivia is produced from raw milk under very simple conditions by unknown processing methods.

7.3.7 Brazil

Several varieties of cheese are made in Brazil in small processing units.

7.3.7.1 Minas frescal (fresh Minas).

This variety originated in Minas Gerais region but it is now made in several regions of the country. It is a fresh cheese made by a very simple method.

It has a high moisture level and the curd is prepared by rennet action. After renneting, only a little syneresis takes place. It is quickly put into moulds and finally salted by rubbing salt over the surface of the cheese. It may be sold three days after processing.

It is a very popular cheese and is found all over the country both as a farm cheese and as a variety made in industrial dairy factories.

7.3.7.2 Minas madurado.

This type is similar to Saint Paulin from France. The processing is based on lactose fermentation and curd production by rennet.

After the curd is cut and washed the cheese is pressed and ripened over a period of 15 to 21 days.

7.3.7.3 Prato.

A semi-soft cheese with a smooth firm consistency resembling Dutch cheese. It is made on farms and also in dairy factories.

7.3.7.4 Requeson.

A fresh cheese prepared from skim milk which is coagulated by natural acid fermentation over a period of 24 hours. After curdling the whey is removed and the curd is washed to reduce acidity. Fresh cream is added to the curd and the mixture is heated to 90°C, cooled and put in a glass dish in which it is sold in the market.

7.3.7.5 Mozzarella.

Brazilian muzzarella is a highly acidified cheese resembling the Italian mozzarella.

7.3.8 Argentina.

7.3.8.1 Cuartirolo.

The typical Argentinian cheese is similar to the fresh crescenza Italian variety. It is made in the traditional way and also with new technology in the large dairy factories. It is a very acid cheese but due to the high level of fat, smooth texture, and fresh flavour, the acidity does not produce an unattractive taste sensation. The high acidity level is developed rapidly during the cheese production due to the Streptococcus thermophilus and Lactobacillus bulgaricus added in a lactic starter culture.

7.3.8.2 Queso de Tafi.

Another typical Argentinian cheese is queso de Tafi (cheese from Tafi) which originated a long time ago in the Tucuman region. It is made with cow's whole milk and formerly sheep rennet was used to coagulate the milk into a curd which was cut by hand, added to straw moulds (forms) and pressed using stones.

Nowadays the milk is coagulated by powder rennet and there are changes in the processing method but the variety is mostly made in traditional processing units.

7.3.9 Uruguay.

7.3.9.1 Cuartirolo.

This Argentinian type is also made in Uruguay.

Italian varieties.

The small amount of farm cheese made in Uruguay is mainly of the hard Italian varieties for grating.

7.4 MIDDLE EAST - SYRIA.

7.4.1 General Method.

Cheesemaking has been practiced in Syria for many centuries.

Practically all cheese names which are common in Syria are based on the region of the origin of the cheese, for example, Akaweh, or Hamweh or on morphological characteristics for varieties such as haloun, chelal, baida.

Cheesemaking in Syria is mainly a seasonal industry and a proportion of the spring surplus milk in the dairying regions and production centres (steppe area) is converted into different types of cheese.

All cheeses produced in Syria may be classified as soft cheeses or fresh cheeses (jobneh) which contain not more than 25–40 per cent of dry matter.

The varieties include Baladi (Baida), hamwi, akawieh, na'aimeh, chelal. These are fresh soft cheese which are consumed fresh within 2–3 weeks after production. However, if the cheese is boiled in a brine, then it can be stored for longer periods.

Village level processing is very common in Syria and cheese is made mainly from sheep and goat milk. Cow milk is also used for local (baladi) cheese.

All Syrian cheeses are produced in largely the same way but the final step of forming the shape

is different from one type to another.

The more important cheeses produced in Syria are:- baladi or baida. White cheese of square shape and white colour hamwi:-a cubic form of cheese produced in the Hama region.

Akawieh: 'fine' cheese produced from the curd after draining off the whey without application of pressure. This gives it a fine texture. Sesame seeds are added to give the cheese a special flavour.

Chelal: it has a form of strings like spaghetti.

Cheeses which are made of raw milk have a stronger flavour but may deteriorate more rapidly.

The process used for industrial-scale production of traditional Syrian cheese involves pasteurisation. starter and rennet addition. Salting is done either by dry salting i.e. spreading dry salt directly on the cheese blocks or by wet salting involving immersion of the cheese blocks in a saturated salt solution.

Cheeses which have not been properly salted, are soft, ripen quickly and develop unpleasant flavours.

In Syria cheese is usually consumed fresh - within 2–3 weeks of production.

7.4.2 Karisheh.

This curd cheese is produced by adding citric acid to boiling whey. Curd with a sweet taste is formed.

7.5 INDIA AND NEIGHBOURING COUNTRIES.

7.5.1 Paneer.

Paneer consists mainly of acid-coagulated milk solids and is used extensively as an ingredient in many cooked vegetable preparations in Northern India, Pakistan, Afghanistan and Nepal.

Paneer making is confined to the North-west frontier regions of the Indian sub-continent. It is produced at small scale and industrial level. Cow, buffalo or mixed milk may be used but buffalo milk is preferred.

The milk is boiled and the coagulation issimultaneously effected by adding the required amount of coagulant acid in a thin stream, within a minute, and mixing it into the milk with a stirrer. Draining is begun when the whey is clear. On a commercial scale, Paneer is processed mechanically into blocks in hoops by putting weights on the hoops (approx 2–3 kg per sq cm for 15–20 min). Drained and pressed curd is cut into suitable sizes and immersed in chilled water for 3–4 hours to make it firm. It is usually sold in pieces without packaging.

An industrial-scale process has been developed by the NDDB. Milk is heated to 85°C through a plate heat exchanger and pumped to a cheese vat and cooled to 75°C. Citric acid solution is added and mixed with the milk to form a coagulum. The curd is left to settle for 10–15 min without agitation. The whey is drained off. Curd is filled into cheese hoops lined with muslin cloth. Pressing of the curd for 10–15 min at a pressure of 3 kg per sq cm. Pressed curd blocks are place in pasteurized cold water at 4°C for 3 hours. The cooled blocks of paneer are cut into 200 g or 500 g portions which are wrapped in vegetable parchment paper before being placed in HDPE or LDPE bags and heat sealed ready for sale.

In India, paneer must meet the following legal requirements.

Moisture (maximum) 70 per cent

Milk fat in dry matter (minimum) 50 per cent

Typical paneer has the following composition:

	Made from	
Percentage	**Cow milk**	**Buffalo milk**
Moisture	52–54	50–52
Milk fat	24–26	28–30
Protein	16–19	13–15
Lactose	2.0–2.2	2.2–2.4
Ash	2.0–2.3	1.9–2.1

The yield of paneer depends on the quality of milk. It is generally 18 to 20 per cent of the weight of the milk used for its preparation.

'White' paneer is a staple food of nomads in Afghanistan. It is traditionally consumed in the northern regions of the Indian sub-continent with dry fruits and nuts as a dessert.

Paneer is also the Hindu name of the seeds of Withania coagulans, the basis of a vegetable coagulant that yields a bitter curd.

Curdled milk products obtained by the admixture with sour milk, pieces of a creeper called Putika, the bark of Palasa trees or Kuyala (Jukuke) was known to the ancient Indians.

However the curdled milk product, paneer, seems to have been introduced into India from the

Middle East perhaps by Persian and Afghan invaders.

A unique Iranian nomadic cheese is called paneer Khiki. This cheese was originally developed by the well-known Bakhtiari tribe which resided in Isfahan (in summer) and Shiraz (in winter). The word khiki means skim. Rennet from the goat or sheep was used to make the paneer, hence the name. When salted it known as paneer-e-shour.

It is only in the past four decades that consumption of paneer has spread to other parts of India. It enjoys the status of haute cuisine amongst Indian vegetarian cooking.

7.5.2 Surti Paneer.

The name of this cheese is derived from the town of Surat in western India where it was probably first prepared and marketed. Once a popular product, very little of it is marketed today.

It is a soft cheese prepared from buffalo milk with crude rennet, salted and kept steeped in acid whey for 2–3 days.

Composition of Surti Paneer:

	Per cent
Moisture	38–42
Fat	35–45
Protein	20–25
Ash	0.4

Surti paneer should have a fairly firm body and smooth texture with no internal cracks. It has a slightly salted, milk acid-curd flavour.

7.5.3 Bandel.

Bandel cheese is an indigenous unripened, salted soft variety of cheese made in perforated pots. It is similar to surti paneer but made from cow's milk. It is available in and around Bandel, a Portugese colony in eastern India, and seems to have derived its name from it.

The cheese is formed into a flattened circular shape and is ready for immediate sale.

7.5.4 Dacca.

This cheese is available in the eastern region. It is similar to bandel but differs from it in that the finished flat round cheeses are smoked in a fire.

Chhurpi. This product is described under Nepal and Bhutan.

Chhanna and Channa-based Sweets. Reference to Figure 1 indicates that the acid precipitation of milk solids leads to paneer and to chhanna and several chhanna-based products including sweets.

The salient features of chhanna and chhanna-based products are summarised below.

7.5.5 Chhanna.

It consists of acid coagulated milk solids used for the preparation of many milk based sweets. It differs from Paneer in that no pressure is applied to remove the whey. Chhanna is widely

used in the eastern parts of India and Bangladesh. Cow milk is preferred since it yields a soft bodied and smooth textured product. Both these characteristics are suitable for the production of high grade chhanna sweets.

Buffalo milk produces a chhanna with a slightly hard body, a greasy and coarse texture, and does not produce good quality chhanna sweets.

Composition of Chhanna:

	Production from:-	
	Cow milk	**Buffalo milk**
Content (per cent)		
Fat in dry matter	53.0	61.0
Protein	37.0	30.0
Lactose	4.6	4.8
Ash	4.4	4.1

Chhanna has the same legal requirements as paneer in India, i.e. a maximum moisture content of 70 per cent and a minimum content of milk fat in dry matter of 50 per cent.

Chhanna from cow milk is light yellow in colour, has a moist surface, soft body and smooth texture. Chhanna derived from buffalo milk is whitish in colour. Both have a pleasant sweetish, mildly acid taste.

Buffalo milk yields a larger amount of chhanna. About 100,000 metric tons are produced annually in India. Chhanna is also produced in rural milk sheds and transported by road and rail to larger urban conglomerates in wicker baskets which allow further drainage of whey.

Chhanna produced in this way is used for the preparation of Sandesh.

7.5.6 Chhanna-based Sweets: Rasogolla.

This sweet is of recent origin having been developed in 1868 by an enterprising Calcutta sweetmeat maker Nobin Chandra Das. It is prepared using fresh and soft-chhanna. In the form of balls 30 mm in diameter with a typical spongy body and smooth texture. Stored and served in sugar syrup.

Freshly-made chhanna is squeezed by hand in a muslin cloth to remove as much whey as possible. 1–4 per cent of the wheat flour/semolina is mixed with the chhanna in a container and kneaded thoroughly by hand to make a dough. The dough is portioned and rolled into balls of about 15 mm diameter having a smooth surface with no cracks - 1 kg of chhanna yields 90–100 rasogollas.

The dough balls are cooked in a specially prepared whey based medium for about 15 minutes. For chhanna made from cow milk, cooking medium with sugar is preferred, and for all other types of chhanna, cooking medium without sugar is preferred.

After the cooking is complete, the balls are transferred to a container with water at 30–35°C for texture stabilisation and colour improvement of the balls. After 5–10 min of texture stabilisation in water, the texture stabilised balls are transferred to sugar syrup. The desired sugar syrup concentration in the final product is 45–50 per cent. This is achieved by dipping the texture-stabilised balls first in 35–40 per cent sugar syrup for 1–2 hours, followed by a second dipping in 58–60 per cent sugar syrup. The product finally acquires the desired sugar concentration after equilibration between the sugar syrup inside and outside the balls is achieved.

The Bureau of Indian Standards has established the following specifications for rasogolla:

	(per cent)
Moisture	45–55.0
Milk fat	5.0
Sucrose	45.0
Protein	5.0

Requirements for syrup:-

Acidity of syrup (ml of N/10 NaOH required to neutralise 100 ml of the syrup) (maximum)	6.0
Concentration of syrup (maximum)	55°Brix
Bacterial count per g (maximum)	500
Coliform count per g	Nil

Reference to Figure 1 shows that several other products are based on chhanna. The salient features of these products:- sandesh, chhanna-murki, pantooa, chumchum, khirmohan and rasmalai are given below in Table 20.

7.5.7 Other Chhanna-based sweets: sandesh, chhanna-murki, pantooa, chumchum, khirmohan, rasmalai.

(See Table 20 p. 76)

7.5.8 Lalmohan.

A product similar to gulabjamun but is made from chhanna and is lighter in colour.

Chhanna is mixed with 2–3 per cent wheat flour and kneaded into a uniform dough. The dough is rolled into small balls and deep fried in ghee until light brown in colour. The balls are transferred to a 60 per cent sugar syrup and allowed to soak for a few hours before being served.

Table 20. Chhanna-based sweets (other than Rasogolla)

Local name	Sandesh	Chhanna-Murki	Pantooa	Chumchum	Khirmohan	Rasmalai
Type of product	Prepared from Chhanna a sweet with a somewhat firm body and a smooth texture. Eighty per per cent of chhanna is converted to sandesh.	Prepared from Chhanna the sweet is in the shape of cubes coated with sugar.	A sweet, based on chhanna and similar to gulabjamun which is prepared from khoa.	A sweet prepared from chhanna coated with sugar or khoa.	A sweet based on chhanna processed like rasogolla	A sweet based on chhanna stored in added sugar.
Area of production		Northern and eastern regions of India	A very popular product in Eastern India		Eastern India	Eastern and northern India
Outline of method	Chhanna (30–45 per cent) and sugar are mixed and kneaded together	Chhanna is kneaded and cut into small		Chhanna is kneaded into a uniform dough, portioned and	Chhanna is kneaded along with 1–4 per cent	Chhanna with 1 to 4 per cent of added wheat

and heated in a shallow vessel after addition of colour and flavour.	cubes of about 1cm.		rolled into balls by hand.	wheat flour into a smooth dough, and is then portioned and rolled into balls having a smooth texture without any cracks.	flour is kneaded into a smooth dough, portioned and rolled into balls having a smooth texture free from cracks.
The heated mass is removed directly into moulds to give the desired shape. The sweets are now ready for eating. Alternatively, the processed mass is put into a tray, cooled and set. It can then be cut into desired shapes or moulded into	The cubes of chhanna are then cooked in boiling sugar syrup until firm.	The mass is kneaded into into a uniform dough portioned and rolled into balls by hand.	The balls are cooked in a boiling 50 per cent sugar syrup similar to the syrup used for cooking rasogollar. The cooking is continued until the desirable firm body and close texture are formed and then the balls are removed from the syrup and cut into	The balls are flattened to a round shape and processed like rasogolla.	The balls are processed like rasogolla and subsequently stored in thickened milk (to a quarter of its volume by heating)with added sugar (5–6 per cent of the original

required forms. There are two types of sandesh available. one a drier variety made from old chhanna. This is normal quality sandesh and has a longer shelf-life than the second type which is softer and is more expensive. It is made from fresh chhanna.	Cooking cubes are then removed from the syrup and after cooling are coated with sugar. They are sometimes flavoured and coloured.	The balls are fried in a a shallow pan using ghee till the balls are deep brown in colour.	half A layer of khoa is with grated khoa. the surface is coated with sugar or khoa and decorated with silver foils .	After cooking the balls dipped in concentrated milk, removed and smeared with grated khoa.	volume of of the milk).
Another type of sandesh, known as Nalin sandesh, is prepared from date jaggery (date gur) between November and February. when dates are plentiful. This product is considered a	This sweet has a firm body and a close texture.	The balls are removed from the pan and placed in a 60 per cent sugar syrup and soaked for			

delicacy and commands a much higher price	a few hours before being served.

7.6 HIMALAYAN REGION - NEPAL AND BHUTAN.

7.6.1 Soft cheese (soft cottage cheese type).

This is the most common form of cheese manufactured and consumed in Bhutan. It is prepared from the sour buttermilk after the butter has been made. The sour buttermilk is poured into a large aluminium cooking pot or vessel and is gently warmed over a fire. The curd soon separates and a yellowish green whey is produced.

The pot or vessel is removed from the fire and the curd is strained from the whey and squeezed by hand into small balls of non-uniform size and weight. The yield of cheese is about twice that of the butter obtained from the same portion of milk.

7.6.2 Sher or Shergum (Nepal), Dartsi (Bhutan)

This type of soft cheese is produced in farm units in Nepal and Bhutan and the Himalayan region at altitudes of 8,000 to 9,000 feet and in areas around Darjeeling.

The milk used may be the sour buttermilk, (mahi), from the churn or the coagulation may be done separately in a pot. The latter procedure results in a better product which remains in good condition for 2–3 days in warm weather or for up to 2 weeks in colder regions of the

countries. The curd is separated from the whey by drainage in a cloth.

The keeping quality depends on the moisture content - the lower the moisture content the longer is the shelf-life.

Salt is not usually added to this cheese (but it may be included in some methods) which unlike the cottage cheese of Bhutan is not in the form of balls but rather is in the form of grains of curd. The soft cheese is wrapped in banana leaves or tree leaves (which have not been washed or chemically disinfected) and then placed in a bamboo basket.

It is used in cooking of traditional foods of the Himalayan area.

7.6.3 Shosim (sogar).

A product obtained by the fermentation of sherghum in anaerobic conditions, in a previously used wooden or earthenware vessel containing non-descriptive type of microorganisms for a long period of time and thus fermented in an air tight vessel. It is used in the Nepalese diet in the form of soups.

7.6.4 Durukho.

Milk solids produced by boiling mahi (buttermilk) are wrapped in a cloth and pressed under stones. When all the whey is driven out, the resulting mass is cut into one-inch cubes and dried in the sun. People like to chew the dry durukho when climbing in the Himalayas. It is also produced from partly skimmed milk.

7.6.5 Churtsi.

In Bhutan, in the mid-hills and Terai areas, a similar type of cheese to dartsi is made by the same methods except that the wooden churn used for butter production is smaller and the conditions under which the butter and cheese are made are more hygienic near to the urban areas.

The traditional buttermilk from which it is made may contain 1–2 per cent fat, 3–3.5 per cent protein and have an acidity of 0.5–1.1 per cent lactic acid.

The ripened cheese is packed in a leather bag or calf skin bag and can be kept for a long time. It fetches a higher price than the similar cheese made under poor hygienic conditions.

It is considered as a delicacy in Bhutan and is said to be a medicine for colds and stomach troubles - but this has never been examined scientifically. This type of cheese has an external appearance of a stone. The large flat slab of curd prepared from the soft cheese is smoked over the fire place in the farm gate huts. The product may last for several years. It is hard and rubbery in texture and smoky and strong in flavour. It can be called a cheese because it has a cheesy flavour. This variety of cheese is not available in Nepal.

7.6.6 Chhuga or Chhurpi.

In areas of the alpine regions of Nepal and Bhutan where the herdsmen and farmers with chouri animals are dependent on milk products as their major form of income the short storage life of soft cheeses poses a marketing problem.

In these circumstances the farmers and herdsmen have developed methods for the further processing of the soft cheese (cottage type) into a hard cheese or chhurpi with an extended keeping quality.

These two varieties are available in the markets in Nepal, Bhutan and Darjeeling district and the Sikkim state of India.

This dried hard casein product is produced from milk of the yak or chouri and is widely consumed by the Himalayan people as a source of nutrients. It is chewed to maintain salivation especially while climbing hills.

It is extensively produced in the alpine and high mountain regions of Nepal, especially the eastern mountains. The production is at the farm gate huts.

Compostion of Chhurpi produced in Bhutan:

	(per cent)
Moisture	8
Fat	11
Fat in dry matter	12.5
Protein	81
Acidity (as lactic acid)	0.2
Coliforms	Negative
Standard plate count	Negative

Chhurpi has no regular shape, size or weight. Chhurpi threaded on a string may have a rectangular shape each piece being from 7–7.15 cm long, 5.5 to 6.5 cm broad, and 1–3.5 cm thick. The average weight of a piece is about 75 g.

Chhurpi is made from whole milk, skimmed milk, and butter milk. Production from whole milk is expensive and the product is soft. Buttermilk and skimmed milk are most frequently used. Hard

chhurpies may be ground into powder and used in soup where it gives a smoky cheese flavour as well as a butter flavour. The products are called chhurpi or durukhwa in Nepal. In Bhutan, and in Sikkim and Darjeeling in India they are called chhuggu and chhurpi respectively. In Bhutan, chhurpi is prepared in large quantities in yak herd areas of Ha district.

In Tibet, in addition to the hard chhurpi, another pliable form of the product is made.

7.6.7 Chhanna.

This acid-coagulated curd is used for sweet-making in Nepal.

Two traditional methods of preparation are recognised and summarised below. The small-scale method is used extensively in Nepal.

In small scale production for domestic purposes milk is heated in a pan to boiling point while being stirred. When the milk is boiling the juice from one ripe citrus lime is added evenly over the surface of the milk which is stirred vigorously. The chhanna is collected by straining off the whey through a muslin cloth and squeezing the lump of curd to remove as much whey as possible.

Compostion of Chhanna Reported from Nepal:

	(Per cent)
Moisture	53.4 to 51.6
Fat	24.7 to 29.6
Protein	14.5 to 17.6
Lactose	2.2 to 2.4

Ash	2.1 to 1.9

Chhanna from cow milk has higher moisture, protein and ash contents and lower total solids i.e. fat and lactose than chhanna made from buffalo milk.

Average yield is about 20 per cent of the weight of milk but it depends on the amount of whey retained in the curd. Other yield figures for chhanna are 13.8 and 20.9 per cent (by weight of the milk used) for cow and buffalo respectively.

The commercial method of production in Nepal is essentially the same as that described for chhanna production in India.

The main feature of the large-scale process is the use of acid whey from previous batches of chhanna to bring about the coagulation.

The acidity of the whey should be about 0.8 to 0.9 per cent lactic acid and old rather than fresh whey, which will be of less uniform acidity, should be used to give a process which is easier to control and a product which is more uniform in texture. Control of the whey by measurement of the acidity by titration is recommended.

8. OTHER MILK-BASED PRODUCTS.

8.1 SOUTHERN AND EASTERN AFRICA - GENERAL.

8.1.1 Blood and Milk Mixtures.

Among the pastoralists (Maasai, Samburus of Kenya) a traditional milk and bovine blood mixed food has been in use for a long time. Four parts milk are mixed with one part of blood and allowed to ferment before consumption. Alternatively the coagulation may be obtained by

heating (Shalo, 1987). It is not clear how important such products are today in the pastoral diets. Recently, Grandin (1987) reported that the Maasai no longer keep male animals long past maturity for bleeding; they now sell them to obtain cash to purchase household needs and production inputs.

8.2 SOUTHCONE COUNTRIES OF LATIN AMERICA.

8.2.1 Dulce de leche, Doce de leite, Manjar.

In all of the southcone countries of Latin America this form of sweetened condensed milk is a very typical dairy product which has been made for many years.

It probably originated in Spain and was brought to Latin America centuries ago. It is almost unknown in other regions of the world.

This product is very well known; it is popular, mainly for children and old people because of its very sweet taste and smooth texture. It has a clear brown colour and pleasant taste and flavour (like preserves). It is normally used instead of preserves in cakes, tarts, biscuits etc. but consumption at home is often on a piece of bread or as a sort of dessert.

For 10 to 20 years the traditional method of preparing this product has been transferred to the big milk product factories, so in Argentina, Brazil, Chile and Uruguay there has been a large production of the industrialised version of the product, one of uniform characteristics and high quality. At the industrial level, in 1986 Argentina produced 48,706 metric tons of sweetened condensed milk and exported part of it. Uruguay produced 3,296 metric tons in 1986 and Chile produced 7,129 metric tons in 1987.

It is prepared from cow milk. The total solids content is concentrated using heat to evaporate

part of the water content. Around 20 per cent (of the weight of milk) of sugar is added without continuous stirring during the heating. It contains 6 per cent of fat and 30 per cent of moisture. The Maillard reaction takes place during processing and as a result the mixture develops a brilliant brown colour that is very typical of the sweetened condensed milk.

8.2.2 Cola de Mono.

This alcoholic milk drink is a very traditional Chilean alcoholic beverage prepared only for adults at very particular celebrations and traditional national parties such as Christmas and Chilean National days.

It is prepared from cow milk, agua ardiente - an alcoholic drink, sugar and some coffee which are mixed, put in a bowl and boiled for a short time in the consumer's household. It contains around 6 per cent of alcohol; has a very clear brown colour; a nice taste and flavour. It is consumed as a cold drink with Christmas cake or with special biscuits as a traditional meal party.

8.3 MIDDLE EAST - SYRIA.

8.3.1 Mouhalayeh.

This product is made from milk by adding starch or other starchy material to make the milk of solid texture.

8.3.2 Ice Cream.

In Syria the local ice cream is produced from milk ingredients by freezing the mix in a special unit which is called boza or kemaa.

8.4 INDIA AND NEIGHBOURING COUNTRIES.

8.4.1 Khoa.

This product is obtained from cow, buffalo or mixed milk by thermal evaporation of milk to 65–70 per cent solids in an open pan. A five times concentration of milk is normally required for the production of khoa.

Khoa, also khawa or mawa, is used as a base material for a variety of Indian sweets. Its origin is not known but it has been prepared for centuries in India as the base material for sweets. About 600,000 metric tons of khoa is produced annually in India alone. It is made by the traditional method by milk traders and halwais.

Khoa preparation has been the easiest way of preserving rurally-produced milk in the flush season. In many places khoa manufactured in January - February is cold-stored for use in the summer season. Such khoa acquires a green colour due to mould growth on the surface. It is therefore known as hariyali (green khoa). This khoa is preferred for the preparation of gulabjamun as it gives a grainier texture to the product. This khoa, on removal from the cold store is immediately mixed with flour and made into gulabjamuns. Hariyali khoa, if left at room temperature for long, starts to smell and breaks down physically. Because of this it is converted into products immediately.

Compostion of khoa:

	per cent	
	Cow	**Buffalo**
Moisture	25.6	19.2

Fat	25.7	37.1
Protein	19.2	17.8
Lactose	25.5	22.1
Ash	3.8	3.6
Iron (ppm)	103.0	101.0

(The high iron content is probably due to the use of iron pans and scrapers).

Legal requirements state that khoa contains a minimum of 20 per cent milk fat. The Bureau of Indian Standards has laid down the following specifications for khoa.

Moisture (per cent by weight) (maximum)	28.0
Fat (per cent by weight) (on dry basis) (minimum)	26.0

Khoa is classified in 3 major types depending upon the specific uses. They are pindi; dhap and danedar with the following compositions:-

Type	Fat (per cent)	Total solids (per cent)	Specific sweets prepared
Pindi	21–26	67–69	Burfi, peda
Dhap	20–23	56–63	Gulabjamun, pantooa
Danedar	20–25	60–65	Kalakand

Milk of high acidity produces a granular khoa known as danedar. Khoa has a uniform whitish colour with just a tinge of brown, a slightly oily or granular texture, and a rich nutty flavour which is associated with a mildly cooked and sweet taste due to the high concentration of lactose.

Buffalo milk is preferred for khoa making because it yields a whiter product with a soft, loose body and a smooth granular texture which makes it suitable for the preparation of high-grade khoa sweets. A minimum of 4 per cent fat for cow milk and 5 per cent fat for buffalo milk is necessary to obtain a desirable body and texture in khoa. Lower levels of fat result in undesirable hard body and coarse texture.

The traditional trade usually pays for milk on the basis of the yield of khoa. Cow milk usually yields 18 per cent of khoa. The yield from buffalo milk is usually 20 per cent.

8.4.2 Peda.

The quantity of peda produced in India exceeds any other indigenous milk-based sweet using khoa as the raw material.

Peda or doodh peda is prepared on a small scale by halwais using khoa as the base material mixed with sugar and flavourings.

A similar product which is very popular in Nepal is called gundpak.

The traditional method of preparation is given in Part 2.

Peda is usually packed in paperboard cartons with a parchment paper of grease proof paper liner. it is usually sold through confectionery shops Peda is whitish yellow in colour and has a coarse grainy texture. Kesar (saffron) peda is one of the preferred pedas in which saffron is used for added flavour and colour.

8.4.3 Other Khoa-based Sweets.

The methods of preparation and various features of other khoa-based sweets - burfi, kalakand, gulabjamun, and kalajanum or kalajam - are summarised below in Table 21.

Condensed Milk-based Products. This sub-group of milk-based products includes rabri, khurchan, basundi, kheer and palpayasam. Features of preparation are given below.

8.4.4 Rabri, Tar (in Nepal).

A specially prepared concentrated and sweetened whole milk product containing several layers of clotted cream. It is a sweet by itself and is not much used as a component of other sweets. It is produced in Northern and eastern regions of India normally from buffalo milk is normally used since it produces a more creamy and chewy consistency.

In comparison to cow milk the higher fat and casein contents of buffalo milk contribute to the formation of a greater volume of creamy layer early in the evaporation process.

Milk (3–4 kg) is heated in a fairly shallow pan over an open fire and allowed to simmer, 5–6 per cent of sugar is added and evaporated to one eighth of the original volume. The preparation time is about 25–40°C minutes depending on the rate of boiling. The finished product consists of non homogeneous flakes partly covered by and partly floating in sweetened condensed milk. By heating the concentrate slightly at the end, a more homogeneous chewy-textured mass is obtained. The following composition relates to Rabbri prepared in Nepal.

Table 21. Khoa-based sweets (other than Peda)

Local name	Burfi	Kalakand	Gulabjamun	Kalajamun or Kalajam
Type of product	A khoa-based sweet	A khoa-based	A khoa-based sweet soaked in a thick sugar	A sweet similar to gulabjamun but

		sweet	syrup. generally served warm as a dessert.	darker in colour. It can be prepared from khoa or chhanna
Outline of method	Khoa is added to an open pan over a low fire. Sugar (25–35 per cent) is added and vigorously mixed to dissolve the sugar and form a smooth mass. Nuts and flavourings may be added during heating to produce different types of burfi.	Kalakand is made from danedar (granular) khoa. Citric acid is added to khoa during the heating process to form well-defined grains.	Khoa (300 g) is mixed with wheat flour (35 g) and baking powder (3 g) and kneaded into a uniform dough.	Khoa (or chhanna) is mixed with a small amount (5–6 per cent) of wheat flour and baking powder (0.5 per cent) and kneaded into a smooth dough.
	The mixture is poured into a tray greased with ghee, spread uniformly and allowed to cool. On cooling the mass sets into a firm product which is cut by knife into the desired shapes and sizes and decorated with foils to	When a semi-solid stage is reached, sugar is added and mixed in. Flavourings and nuts may also be	The dough is rolled into small balls and deep-fried in ghee in a shallow pan until the balls acquire a golden brown colour. The balls are then removed and placed in a 60 per cent sugar solution and allowed to soak for a few hours before being	It is portioned and rolled into balls and deep fried in ghee until the surface is charred to almost a black colour. Frying in high heat gives a black colour to the crust but the inside remains white.

	increase the appeal.	added at this stage.	served.	
		After five minutes the heated mixture is tranferred to a tray greased with ghee for cooling and setting. When cooled to room temperature the firmly set product is cut to the required shape and size.		The balls are then soaked in a 60 per cent sugar syrup for a few hours to allow the sugar syrup to penetrate inside the kalajamun.
	Burfi is packed in paper board cartons linked with parchment or greaseproof paper.			It is then removed from the sugar syrup and stored or consumed.
Composition and characteristics	The Bureau of Indian Standards has laid down the following specifications for burfi:	The sweet has light caramel colour and a granular	The composition of gulabjamun, on a drained weight basis, is:-	
	Mawa Other		Fat 10 per cent; protein 6	

	burfi	types	texture and firm body.	per cent; sugar, 42 per cent; other solids 14 per cent.
Moisture (per cent by weight) (maximum)	15.0	15.0		The Bureau of Indian Standards has laid down the following specifications for gulabjamun.
Milk fat (per cent by weight) (minimum)	12.5	10.0		Moisture (per cent by weight) (maximum) 30.0
Lactose (per cent by weight) (minimum)	15.0	12.0		Milk fat (per cent by weight) (minimum) 8.0
Sucrose (per cent by weight) (maximum)	48.0	40.0		Protein (per cent by by weight) (minimum) 8.0
Acidity (per cent as lactic acid)	0.35	0.45		Concentration of sugar in syrup (per cent by by weight) (minimum) 40.0
Standard plate count (per g) (maximum)	30,000	30,000		The requirements for syrup for gulabjamun: Acidity (m1 of 0.1 NaOH required to neutralise 100 m1 of the syrup) (maximum) 6.0
Yeast and mould count (per	10	10		Concentration of syrup (minimum) 62.4 Brix The product is round or cylindrical in shape, dark brown in colour and has

	g) (maximum)	firm body and smooth texture soaked in a thick sugar syrup.
	The product is white to light cream in colour. smooth to granular texture.	

	(per cent w/w)
Water	30
Milk solids	70
Lactose	17
Protein	10
Ash	3
Cane sugar	20

8.4.5 Khurchan.

A concentrated, sweetened whole milk product, similar to Rabri. It is used for direct consumption. It is produced in the Northern region of India almost exclusively from bufflo milk as it gives a higher yield than cow milk. The final produce has a slightly cooked flavour, which is relished.

	(per cent w/w)
Moisture	27.9
Fat	23.6
Protein	15.4

Lactose	14.9
Sugar	15.2
Ash	3.0

8.4.6 Basundi.

A concentrated milk to which sugar, flavours and nuts are added. The product is served chilled as a dessert.

The origin of the product is not known but it has been traditionally prepared for centuries in the western part of India as a dessert, served on special occasions such as weddings. About 25,000 metric tons of basundi are produced annually in India from cow and buffalo milk on a small-scale.

Milk, in a shallow pan is boiled on a low flame. The heat coagulated film that appears on the surface of the milk is collected and spread on the sides of the vessel. The volume of milk is reduced to 50 per cent of it's original volume. The pan is removed from the fire and sugar is added along with nuts and flavours. The mass is mixed until the sugar is dissolved. The product is cooled and served chilled.

Composition:

	(per cent w/w)
Fat	18–22
Milk	28–32
Sucrose	20–33

Basundi looks like condensed milk with flakes. It has a light brown colour with thin flakes in a

thick fluid. It has a pleasant flavour similar to condensed milk. The cooked flavour is relished by the consumer.

8.4.7 Kheer.

A sweetened product of thick consistency resembling rice pudding commonly consumed in the West. The product is prepared for immediate consumption. It is produced in northern, western and central regions of the Indian sub-continent. This product is widely consumed in the regions mentioned above. In Nepal, the housewife perpares kheer by concentrating whole milk in open pans with the addition of sugar (6–8 per cent), rice (6–7 per cent), ghyu, cashew nuts, cardamon and other spices.

Composition:

Plain kheer (Nepal)	(a)	(b)
Water (per cent)	45–55	40–50
Solids (per cent)	45–55	50–60
Milk fat (per cent)	15–25	0.5
Lactose (per cent)	14–16	14–16
Protein (per cent)	12–13	12–13
Ash (per cent)	3–3.5	2.5–3.0
Cane sugar (per cent)	15–25	15–25

(a) whole milk
(b) skimmed milk

8.4.8 Palpayasam.

A sweetened product; similar to kheer and resembling a rice pudding produced in Southern India. Vermicelli or semolina may be substituted for rice, fruits like jack fruit are optional.

8.4.9 Frozen Milk Products: Kulfi or Malai Kulfi.

This indigenous ice cream is based on milk and is popular in the hot summer. It is frozen in small containers.

The preparation of kulfi involves concentration of a milk and sugar mixture to 50 per cent volume. It is cooled before addition of cooled cream, crushed nutes and selected flavourings. The milk is added to moulds and frozen in a vessel containing an ice and salt mixture with a 1:1 ratio.

The Bureau of Indian Standards has laid down the following specifications for kulfi.

	Plain Kulfi	Fruit, Nut and chocolate kulfi
Total solids (per cent, w/w) minimum	35.0	30.0
Milk fat (per cent w/w) minimum	8.0	6.0
Proteins (per cent w/w) minimum	3.5	3.5
Acidity (per cent w/w lactic acid) minimum	0.3	0.3
Sucrose (per cent w/w) minimum	13.0	12.0
Total colony count (per g) maximum	250,000.0	250,000.0
Coliform count (per g) maximum	100.0	100.0
Phosphatase test on mix	-ve	-ve
Presence of starch	-ve	-ve

8.5 HIMALAYAN REGION - NEPAL AND BHUTAN.

8.5.1 Khoa.

This is an important traditional milk product in Nepal although it originated in India. It is very suited to small-scale production to utilise small quantities of surplus milk. Its method of preparation ensures a reasonably long storage life.

Due to the requirements of the sweet makers the demand for khoa always exists and this seems likely to be permanent.

Khoa is a concentrated whole milk product made either from cow or buffalo milk or mixed cow and buffalo milk by heating the milk in open pans over a fire to evaporate the water until the total solids increase to 70 to 75 per cent and the moisture content decreases to 25 to 30 per cent.

Traditional khoa can only be made by processing small quantities of milk at a time. The concentrated material from large volumes cannot be easily controlled during the last stages of preparation.

Because of this not more than 3 kg of milk can be processed in one vessel. Sometimes the khoa maker can work the milk in two vessels (side by side) simultaneously. The preparation of khoa is laborious, consuming a lot of time and requiring practice and patience.

Other Traditional Products made in Nepal and Bhutan. Information from Nepal and Bhutan on the traditional products kheer and rabbri has been included in references to these products above under India and neighbouring countries.

An indication of the relationship between traditional milk products of Nepal and Bhutan, those of India and products of commercial significance in developed dairy industries is given in Table 22.

Table 22. Relation between traditional milk products of Nepal and Bhutan and India and those of developed dairy industries

	Traditional milk products			Products of developed dairy countries
	In Nepal	In India	In Bhutan	
1.	dudh	dudh	om, nu.	milk
2.	cream, malai, tar	cream, malai, sar	-	cream, clotted cream
3.	khoa, rabbri	khoa, rabbri	-	dried, evaporated sweetened condensed milks
4.	chhanna, panir, sher,	chhanna, paneer	dartsi, dha- chi chhurtsi, shode.	curd cheese, cottage cheese
5.	naunighu	deshi butter, (deshi makhan)	ma., ma-a, martang, machechechep	butter, or deshi butter
6.	dahi	dahi	shyo	yoghurt
7.	mahi	lassi	dhao	butter milk drink, fermented milk drinks
8.	whey	whey	dha - chu	whey
9.	ghyu or khareko ghyu	ghee	-	clarified butter fat, butter oil
10.	chhurpi, durukhwa	chhurpi	chhugu, chhugo, chhurpi	hard cheese
11.	dahi sherbets mahi	dahi sherbets lassi	- butter milk ice-water	yoghurt ice-water drinks drinks

12.	sherbets kheer	sherbets kheer	thup	milk rice

Source :- Nembourg (1989)

V ECONOMIC IMPORTANCE OF TRADITIONAL MILK PRODUCTS

1. SOUTHERN AND EASTERN AFRICA - GENERAL

In the absence of accurate data on the contribution of the traditional livestock sector to the national milk production of individual countries within the region, it is difficult to give exact figures on the economic contribution of traditional dairy products in the region as a whole. However a reasonable estimate can be made by making extrapolations which are based on reasonable assumptions. The basis of these assumptions is the published FAO estimates (FAO, 1987) for 1985 for the individual countries listed in Table 3, as well as other published data and the personal experience of the contributor within the region. From Table 3, it can be seen that in 1985 the sixteen countries produced a total of 4892, 780 and 1085 thousand metric tons of cow, sheep and goat milk respectively. It follows that:

a. **In view of the limited distribution of sheep and goat milk both between and within the countries in the region, it can be assumed that most of the milk from these species and that of the camel is consumed within the pastoral communities (Kebede, 1984, Kerven,**

1987) and therefore any amounts marketed are negligible.

Hence while considering the economic contribution of traditional dairy products in the region, attention will be given only to cow milk which constitutes about 70 per cent of the milk produced in the region and nearly 100 per cent of the marketed milk and dairy products.

b. **Reports dealing with the performance of the dairy industry in some of the countries (see references Table 4), show that less than 10 per cent of locally-produced milk enters the commercial market which means that over 90 per cent of milk produced locally is consumed within the pastoral/agropastoral communities and their immediate neighbourhoods. This is also true for a country like Kenya which has a relatively well-developed milk marketing system. Chema (1984) reported that only 10 per cent of the estimated 463,000 metric tons of milk produced by Kenyan traditional pastoralists was marketed, as compared to the overall commercial offtake of 42 per cent.**

c. **Except for Kenya and Zimbabwe where about 50 per cent of the milk produced is from smallholder and/or commercial farm standard dairy cattle, in most of the other countries in southern and eastern Africa, the traditional sector amounts for 80–90 per cent of total milk produced.**

d. **Since traditional dairy products are associated mostly with the traditional cattle keepers then the amount of milk involved in traditional processing may be taken to be at least 80 per cent of the total milk produced i.e. total milk less 10 per cent that is produced in the commercial sectors and another 10 per cent which is marketed from the traditional sector via milk processing plants.**

Following the above hypothesis, Table 4, on the basis of FAO's (1985) estimates for cow milk production, gives the estimated amounts of milk that may be available for traditional processing and marketing.

For seven countries where figures for commercially processed milk were available, these have been included in Table 4 to illustrate the fact that except for Kenya and Zimbabwe, only a small proportion of local milk production is processed and marketed by commercial milk processing plants thus making the presumed 10 per cent offtake too generous an estimate in the majority of the individual countries.

On the basis of the above assumption, the total amount of milk that may have been processed and/or marketed traditionally was about 3.485 million metric tons for the whole region. Most milk is traditionally processed into fermented milk which is in turn churned to give butter and buttermilk. Most of the buttermilk is consumed within the households except in Ethiopia where most of it is turned into cottage cheese (ayib). In some pastoral communities in southern Sudan, buttermilk is bartered for grain at varying exchange values depending on the season (Kerven, 1987). In most cases the butter is boiled into ghee which fetches high market prices due to the high demand for cooking oil in general and ghee in particular which is preferred by Indian communities in the urban centres of some countries in the region. About 75 per cent of the ghee produced is sold while the remainder may be retained for home use.

It has been reported that the efficiency of fat recovery in the traditional churning of fermented milk in Ethiopia was about 50–67 per cent in most of the households although under cooler temperatures in the Ethiopian highlands fat recoveries of 75–77 per cent were recorded (O'Mahony and Bekele, 1985). Assuming that 50 per cent of the milk available for traditional processing (Table 4) is fermented and churned to butter (Kerven, 1987) with a minimal 50 per cent fat recovery (O'Mahony and Bekele, 1985) and that zebu milk contains about 5 per cent

butterfat, the amount of ghee containing 99.5 per cent butterfat that may have been produced in 1985 is shown in Table 23 together with the value of imports of butter for 1984 (FAO Trade Yearbook, 1985).

From Table 23 it can be estimated that a total of about 43,400 metric tons of ghee may have been produced and it is possible that 75 per cent of this (about 32,000 metric tons) could have been sold or exchanged for other goods or foodstuffs. The balance of 25 per cent may be taken to account for dairy products retained for home consumption by those who sell part of their dairy produce and those who, like the Lahawin pastoralists in Eastern Sudan, traditionally do not sell their dairy produce (Morton, 1988). Due to the wide price variations between the different countries within the region it is difficult to estimate the exchange value of the ghee that might have been produced or sold. However, from Table 23, the amount and value of butter imports give an indication that the cost of butter imports to the importing countries in 1984 was about 2 US dollars per kg butterfat. The local price of one kg of butter has been reported to be the equivalent of 5–11.5 US dollars in Ethiopia (O'Mahony and Bekele, 1985), 3.5 US dollars in Burundi (Kakunze, 1984) and in Tanzania butter is currently retailing at 3–5 US dollars per kg while the cost of butter oil imported through the World Food Programme (WFP) commodity aid programme is valued at 415.84 Tshs (4.2 US dollars) per kg (Lohay, 1988).

Table 23. Value of butter imports and estimated quantities of ghee produced from the traditional livestock sector in southern and eastern Africa (1985)

COUNTRY	Traditionally processed milk estimate (thousand metric tons)	Estimated amount of ghee PRODUCED (thousand metric tons)	Butter** imports (1984) (metric tons)	Value of butter imports (1984) (thousand US $	Average price per kg butterfat (US $)
Botswana	28.5	0.09*	488	328	0.672

Botswana	38.5	0.96*	488	328	0.672
Burundi	9.5	0.24	80	140	1.75
Ethiopia	238	5.92	2,000	4,000	2.00
Kenya	200	4.98	1,625	4,060	2.11
Lesotho	29	0.23	-	-	-
Madagascar	16.5	0.41	221	437	1.98
Malawi	15.5	0.39	18	50	2.78
Mozambique	26	0.65	3,300	6,500	1.97
Rwanda	29	0.72	2	6	3.00
Somalia	57.5	1.43	700	400	0.57
Sudan	680	16.92	1,700	2,500	1.47
Swaziland	15	0.38	180	153	0.85
Tanzania	169	4.22	1,300	2,000	1.54
Uganda	145.5	3.62	600	1,100	1.83
Zambia	29.0	0.72	150	330	2.20
Zimbabwe	64	1.59	-	-	-
TOTAL	1792.5	43.40	12,364.0	22,004	

*** Obtained by 38.5×0.05)×0.5)×0.995)**

Source:

**** FAO Trade Yearbook, 1985**

Source: Kurwijila (1989)

It is therefore reasonable to assume that the price of ghee paid to pastoral producers in the rural areas will be in the region of 2.5 to 3 US dollars/kg. This implies that the cash flow into the pastoral economy through traditional ghee sales may well be in the region of the equivalent of 80 to 96 million US dollars in the sixteen countries of southern and eastern Africa. To this can be added the value of approximately 7.25 million US dollars from the sale of about 14,500 metric tons of cottage cheese in Ethiopia. This figure was obtained by assuming that half the 232 million kg of the buttermilk available from traditional buttermaking in Ethiopia (Table 4) is turned into cottage cheese (ayib) valued at 0.5 US dollars per kg while the rest is consumed as buttermilk. Furthermore, from the data given by Othman (1987) and information given by Kerven (1987), the amount of gibna bayda cheese made in Sudan is likely to be between one and two thousand metric tons per annum, the value of which is difficult to tell due to lack of any definite data on local prices of the products. Taking into account the conservative assumptions adopted here the total value of traditional dairy products in the region could easily be around 100 million US dollars. This is a substantial income per capita of the pastoral and agropastoral communities involved in traditional dairy processing. In a case study of pastoralists of South Darfur, Sudan, Kerven (1987) found that income from the sale of dairy products contributed between 40–44 per cent of a family's annual income.

Besides providing cash income to the rural communities through the sale of preserved dairy products, traditional milk processing involves other economic aspects such as the creation of rural employment in pottery for the rural women who make clay pots used in milk processing and to the middlemen and hawkers who market some of the milk products in urban and fringe urban areas. Youths at home who help their mothers to market dairy products, or to milk the cows (in some communities women are traditionally not allowed to milk cows) and look after the cattle, get some kind of employment.

2. SOUTHERN AND EASTERN AFRICA - ETHIOPIA

Of the traditional milk products, butter is a commodity that has a ready market in any part of the country and also in some other countries of the region. In rural Ethiopia especially, where there is no liquid milk market, butter is the only milk product which is produced for marketing. The price of butter fluctuates depending upon demand and supply. There is an increased demand for butter for Christian and Muslim festivals. During the 40 to 56-day fasting period (March, April and May) of Lent, observed by the followers of the Ethiopian Orthodox church, the demand for milk and milk products is low. Similarly the supply is low as this period falls within the dry season, October to June. Regardless of the shortage of milk during the dry season, the milk producers in or on the fringe of urban areas find it difficult to market the dairy products during Lent.

According to statistical data of the Ethiopian Customs Office, butter and ghee are export commodities to the Middle East. However, since 1978, the export of ghee has declined and that of fresh butter is increasing. In 1980, only 126 kg of ghee and 5000 kg of butter were exported.

Sour milk (irgo), sour butter milk (arrera) and cottage cheese (ayib) have limited markets. Those farmers near urban centres have a market outlet for these products.

Some itinerant traders buy cottage cheese from rural markets, accessible by road, and transport the product by bus, lorry or any other public transport, to large urban centres. These products are of economic importance to the producer. There are large number of butter dealers in urban centres who make a sound business. The marketing of these products generates the scarce cash income to the farmer.

3. WEST AFRICA - MALI

Trade in milk and milk products is confined to local markets. from the data on imports of milk

and milk products it is clear that there is demand. It is also true that a large volume of milk is produced within the country. However, the local production does not reach the consumer owing to lack of marketing infrastructures.

On the other hand, those producers who are close to local markets do market their products.

4. SOUTHCONE COUNTRIES OF LATIN AMERICA

These products have a tremendous importance for small producers who are very numerous in all of the southcone countries. even more importantly, each small producer has a family of at least five people. That means that a very large number of people depend economically on these activities within the region.

Small processing units normally are family ones, then all the members of the family have got a job in it, but medium processing units need more workers than their own family provides so these activities provide jobs for an important part of the rural population in every country. Unfortunately, the number of small and medium processing units are not precisely known yet in those countries and the total people working in them could not be estimated, although it is a big number indeed, e.g. goat cheese production is the main activity done at the small producer level of agricultural activities in the La Serena region of Chile. In Paraguay, Bolivia and Peru more than 50 per cent of the total milk supply is processed by the small processing units.

Generally speaking, this activity is one of the most attractive of those of the agricultural industry since it has less financial risk than some others, for example cropping.

In addition to the processing of a traditional product the farmer obtains several other benefits such as:

a. **He gives an additional value to the milk produced on his farm so the financial income is greater than that of selling raw milk,**

b. **Sometimes further income is obtained through the encouragement of the farm's own marketing of the product either individually or through cooperatives,**

c. **Normally the unit for traditional milk products has a regular milk intake at least during the Spring-Summer seasons, if it is a very small unit, but many of the processing units have a constant level during the year,**

d. **In addition, consumption habits of the population sometimes allow traditional products to obtain higher prices that the parallel industrial version. However, that does not always mean a higher income for the dairy producers because of the profits required by the middlemen.**

Nevertheless it has to be clear that this sector does not obtain its full potential mainly due to the poor quality of the product obtained. At the milk processing units there are some losses due to (a) the poor yield of the products because of lack of technology and quality control, (b) complete loss of the batch because the product has not been successfully made, (c) prevalence of reprocessing of second quality products, (d) loss of financial return from products requisitioned by the state authorities when it is forbidden to sell traditional products made at a dairy farm.

The traditional milk products sector contributes to reduce the normal deficit of milk from those southcone countries in Latin America where the imports of dairy products are reduced at present. In addition in some countries traditional dairy products are the main milk products made there, so most of the milk consumed comes from this sector.

In the same way small processing units actually avoid the spoilage of milk produced far away from the cities, through the milk being transformed into products with a longer shelf life than fresh milk.

Finally, from the economical point of view, traditional dairy products have a tremendous potential which could be used to develop the following:-

a. **To increase the milk yields of individual animals,**

b. **To increase the yield of product obtained (kg milk/kg product),**

c. **To improve the quality of the products.**

Consequently, milk production per capita would be higher than now and so imported dairy products could be reduced substantially. This means that more of the population with a low salary could have the opportunity to increase milk consumption for all their family especially children and old people.

Small processing units and all of the activities linked to them, avoid more of the population, particularly young people, leaving the rural areas to go to the big cities where they normally cannot find work and so they must live in very poor financial conditions.

For all of the reasons mentioned, it can be seen that the agricultural sector is economically very important for every country, so economical help and practical policies should be encouraged by the respective governments in order to improve the actual conditions of the traditional milk product industry.

5. MIDDLE EAST - SYRIA

The sale of milk products, in many forms and many tastes, surplus to the requirements of the rural milk producer has been well known in Syria for many years.

The amount of milk available for processing in large industrial plants and the private and smaller factories may reach 35 per cent of the total milk produced in Syria.

In 1987 the value of milk production in Syria was 5094.9 million Syrian pounds. This represented about 35 per cent of the total value (14,424.7 million S.P) of agricultural production in the same year.

The economical importance of milk and its products in Syria is shown below.

Table 24. The value of milk and its products from 1983–1987 (million Syrian pounds)

	1983	1984	1985	1986	1987
Constant prices	1759.3	1575.5	1709.5	1586.1	1664.4
Current prices	2442.4	2401.9	3058.2	3523.9	5094.9

In spite of the fact that Syria produces 1.1 million metric tons of milk of which 35 per cent (or 373,217 metric tons) are consumed as fresh milk, the production is not sufficient to meet the people's requirements.

Syria has to import dairy products to bridge the gap between the available milk products produced in the country and the population's demands.

In 1987 Syria imported 11,630 metric tons of milk (concentrated or sweet and preserved cream) valued at 179.7 million Syrian pounds, 15,179 metric tons of butter and ghee (valued at 228.6 million S.P.) and 1373 metric tons of cheese valued at 35.9 million S.P.).

The importance of the existing production of traditional milk products is indicated in relation to import saving.

6. ASIA

6.1 INDIA AND NEIGHBOURING COUNTRIES

With an annual milk production of 46 million metric tons in 1986–87, India ranks third in the world after the Soviet Union and the United States of America. Milk production is expected to further surge forward in the coming years to cross the 61 million metric tons mark by 1995. The target for 2000 AD is 70 million metric tons.

Milk and milk products play a vital role in the agricultural economy, being the second largest agricultural product in India. In 1984–85 the value of milk and its products exceeded Rs.100,000 million, ranking after rice, but before wheat. Equally important, if not more so, is the role of dairying in providing sustenance to millions of farmers, constituting 75 per cent of the total population in some 80 million farm households distributed over 550,000 villages, constituting the bulk of rural poor, with an annual income of less than Rs. 3,800 per family. Milk provides both nutrition and supplementary income to these weaker sections.

Over 5 million farm families, in 49,000 village milk producer's cooperatives, sell on an average some 8 million litres of milk every day, after retaining some 30 per cent of it for their own consumption. Sale of milk fetches them about Rs. 30 million per day aggregating Rs. 10,000 million per year.

The value of output of the Indian dairy industry and its growth in the national economy is illustrated in Table 25.

Table 25. The value of output of dairy products in India (million rupees)

Year	1951	1961	1971	1981	1985	1986	1990*	2000*
Value	8,700	10,200	19,125	75,460	12,6900	131,700	204,000	325,000

*** Projected**

Table 26, gives the value of the output from agriculture and livestock in 1984–85. Output from milk and milk products constituted 13 per cent of the total output from agriculture and livestock farming.

Table 26. The value of output from agriculture and livestock in 1984–85 (thousand million rupees)

Crops	
Cereals:	281.2
-Rice	162.0
-Wheat	72.3
Pulses	46.3
Oilseeds	71.7
Sugar, etc.	41.1
Fibres	32.4
Fruits & vegetables	70.3
Miscellaneous crops +	33.6
By - products	36.6
- Straw & stalles	27.1
- Other products*	9.5

Total value of output	613.2
Livestock	
Milk & milk products	105.4
- Unprocessed milk	68.2
- Ghee	24.7
- Butter	4.1
- Lassi	8.3
Meat & meat products	17.4
Hides & skins	3.1
Eggs & poultry meat	14.7
Wool & hair	0.9
Dung	15.4
Increment in livestock	4.7
Other products++	3.4
Total value of output	165.0

*** Includes rice bran, rice husk, sesamnin sticks, bagasse and cane trash**

+ Includes fodder, grass, farm-yard wood

++ Includes bones, horns, hooves and cocoons

The pattern of utilization of milk in the country and changing trends over the years is given in Table 27.

Table 27. Milk utilisation pattern in India (as a percentage of the available supply)

Use	1951	1961	1984/5
Liquid milk	39.3	45.1	46.0
Milk powder+	-	-	3.0
Ghee	39.5	31.8	28.0
Makkhan (butter)	6.0	6.4	6.5
Khoa	4.5	4.7	5.5
Cream	0.7	1.9	0.5
Curd	8.9	8.2	7.0
Ice Cream	0.7	0.7	0.7
Cheese**	-	-	2.0
Others	0.4	1.2	0.8

**** includes paneer, chhanna and processed cheese.**

+ includes infant milk food.

India alone produces some 650,000 metric tons of ghee valued at Rs. 32,000 million. The value of resultant lassi is Rs. 10,000 million, some 600,000 tonnes of khoa valued at Rs. 18,000 million is produced in India along with some 100,000 metric tons of chhanna valued at Rs. 3,000 million. The value of khoa and chhanna produced in India is probably twice the value of all the milk handled by the organised sector in the country.

The traditional dairy products sector in India, like its agricultural economy, is grossly under managed. However, it provides economic opportunities that even the western dairy world would be envious of. The value of khoa and chhanna-based sweets could possibly exceed US $ 4 billion. In the absence of reliable data, the above figures are only rough estimates, but

highlight the significance of the traditional dairy products in the national economy.

6.2 HIMALAYAN AREA - NEPAL AND BHUTAN.

Livestock keeping plays an important role in the socio-economic and cultural life of the people inhabitating the alpine and mountainous regions of Nepal and Bhutan. The yak, chauries and cows fulfil an indispensable role for the people in the Himalayan area. The people of this area have many applications for these animals and they are used for several purposes. Livestock farming remains as one of the major income sources for the farmers residing in high mountains and hilly regions. These livestock provides the farmers with more than 50 per cent of their yearly income besides providing them with nutritious food, and milk and also acting as motive power to sustain agricultural activity.

In the Himalayan area herds are mostly scattered, living in jungle grazing systems developed independently. Almost simultaneously in the hills cows are grazed for the production of draught animal power, dung and compost and are fed with some supplementary feed. In particular in the hills of Nepal, about 20 per cent of the milk is consumed direct in liquid form and the rest is used for conversion into ghee, dahi and mahi. In the Terai area of Nepal, local cows are herded throughout the day for grazing, usually not given much additional feed, usually producing no milk but are kept for the value of male calves, dung and compost. As a rule buffaloes are kept for milk production and are given supplementary feed and concentrates. Milk from the buffalo is consumed at home as well as converted into traditional milk products like curd, mahi, ghyu (ghee) etc.

In the high mountains of Nepal and Bhutan, yaks and chauries are the main source of income. The herd owners make traditional products such as butter and the butter milk, which is churned out is converted into chhurpi or sheror shergum. All these products are sold in

established markets and exchanged for food, salt etc. These people depend mainly on the trade in butter and chhurpi. Khoa and chhana making in Nepal and India is mostly in or near town and cities. However some producers or even middlemen living in small areas of milk production away from towns used to make khoa from the locally collected milk and sell it to the sweet shops. In Nepal the statistics of the production of khoa, chhana, chhurpi and sher or shergum are not available. Survey and collection of data for these products as well as traditional butter has never been done. However some statistics for traditional ghee or ghyu were available from the trade promotion centre of Nepal for the fiscal year 1987–88. The figures are shown in Table 28.

Table 28. Traditional ghee or ghyu production in Nepal in 1987–88

	Development region	Production (kg)	Local consumption (kg)	Local consumption (%)	Exportable quantity (kg)
1.	Eastern	3,917,562	1,166,229	29	2,751,333
2.	Central	1,328,899	257,692	19	1,071,207
3.	Western	2,027,125	814,450	40	1,212,675
4.	Mid-western and Far-western	4,487,116	982,399	22	3,504,717
	Total	11,760,702	3,220,770		8,539,932

Source:- Trade promotion centre, Nepal. 1987-88.

Nembang (1989)

According to these figures the local consumption is estimated at 27.39 per cent of the total and the exportable is 72.61 per cent. It can be estimated that 60–80 per cent of ghee produced in

Nepal is surplus to local requirements.

The home consumption of ghee by the farmers is estimated to be from 4 to 20 per cent of their production and of the national production of ghee or ghyu about 62 per cent is from mid-western and far-western regions. Around 8540 metric tons of ghee is exported to India at the present time. The traditional ghee or ghyu is packed and sealed in 16 kg tins and sold under the famous name of Nepal ghee.

Farmers of the remote areas are financially better off making chhurpi as well as traditional ghee. The most of the remote areas do not have agricultural crop products. They depend upon income from traditional milk products for their livelihood.

In Bhutan, in 1988, it was observed (Nembang, 1989) that the farmers of remote areas are fully dependent on cheese, chhurpi, and traditional butter products. In the remote areas of Bhutan as in Nepal, there are no agricultural products except those of traditional dairy production. In particular in eastern Bhutan, the farmers, make cheese (cottage type) and butter. They exchange or barter these products for food and partly sell for cash. The production of traditional butter and white cheese (cottage type) in five districts of eastern Bhutan was 955.6 metric tons and 424 metric tons respectively.

The barter system is very common in Bhutan. Farmers exchange their dairy products for food grains. The exchange rate for Bhutan is also fixed on the basis of food and milk product prices. The farmers of remote areas of eastern Bhutan are fully dependant upon the income from traditional milk products. The whole economy of farmers is based on sales or exchange of milk products for cash and food for their livelihood. This is particularly true for the people who are living in the alpine regions of Nepal and Bhutan. Governments should launch a special programme for the development and improvement of dairy production. As a matter of fact 90.7

per cent of cow milk, 96.4 per cent yak milk, 73.6 per cent buffalo milk are converted into milk products, such as chhugu, soft cheese, butter, smoked cheese in Bhutan.

VI NUTRITIONAL IMPORTANCE OF TRADITIONAL MILK PRODUCTS IN THE NATIONAL DIET.

1. SOUTHERN AND EASTERN AFRICA - GENERAL.

In considering the contribution of traditional dairy products in the diets of the people in the countries of Southern and Eastern Africa it is important to look at the overall availability of milk. Very often figures obtained by relating the estimated amounts of milk produced in a given country with the human population are taken as the per capita milk consumption statistics (see Table 3). These figures may be useful as general indicators of the level of milk availability to the general populace but have limited value as criteria for assessing the nutritional role of milk in national diets.

To evaluate accurately the contribution of milk to the nutrition status of the people we need to be aware of the traditional role of milk in the diets of different communities within a region or country. Whereas the majority of the urban and semi-urban populations consume purchased milk, the majority of the rural population (who form at least 80% of the total population within southern and eastern Africa) consume home-produced milk. This means that in the urban

sector the level and pattern of milk consumption within households relates very closely to the availability of market milk and milk products, income levels and distribution, age groups and cultural backgrounds of the urban dwellers.

In the rural areas, milk consumption levels and patterns depend on the degree of pastoralism or non-pastoralism within a given community. Therefore depending on the geographical distribution of traditional cattle herds one is bound to encounter, within a given country in the region, areas where milk and milk products constitute a major component in the diet while in some non-pastoral communities the consumption of milk particularly among adults, may be non-existent. Table 29 adopted from Schneider (1984), gives a general overview of the distribution of pastoralism within the major rural peoples of Eastern Africa. Included also is an arbitrary indication of the role of milk in their diets. Generally as the number of cattle kept per person decreases so does the dependency on milk as a source of dietary energy. At an average yield of 1 kg milk per day containing 700 kcal, about four milking cows are required to meet the energy requirement of an adult person requiring 2600 kcal/day. These levels can only be achieved in strictly pastoral communities owning large numbers of cattle per head. Households with less cattle per head have to rely on other foodstuffs apart from milk and meat or blood to meet their nutritional requirements. A review of some published information will serve to elaborate this point further.

In a study of the role of milk in the diet of pastoralists of South Darfur, Sudan, Kerven (1987), found that 25 per cent of the energy needs were met by milk, implying the consumption of the equivalent of 1 litre of milk per day containing about 700 kcal per litre. In another report, Kerven (1987a) showed that milk (in the form of traditional dairy products) contributed 51 per cent and 63 per cent of the total calorific intake of individual and group Maasai ranchers respectively. This translates into about 1.9 and 2.3 litres of milk per day. These figures are consistent with average milk consumption figures of 0.84 and 1.75 litres/day reported for small

scale (35 cattle per household) and large scale (367 cattle per household) Maasai group ranches in Kenya (Leeuw et al 1984). Similar figures have been reported recently by Majubwe (1987) who found milk consumption in four immigrant Maasai settlements in Morogoro, Tanzania, owning an average of between 104 and 221 cattle per household to be between 1.8 litres and 2.7 litres per person per day. Most of the milk was consumed as fermented milk or buttermilk - a by-product of butter making. These milk consumption figures are very high by any standards. However an analysis of the nutrient profiles of such high levels of milk consumption (Kurwijila, 1988a) show that while the needs for protein in general and essential amino acids are more than adequately satisfied, the supply of iron, niacin, vitamin C, vitamin A, thiamine and energy are never fully met by a purely milk diet on which some pastoralists attempt to subsist entirely, particularly in the rainy season when milk is plentiful (Kerven, 1987). Due to changing circumstances especially the seasonal nature of the milk supply and frequent droughts, most pastoralists, including the Maasai in eastern Africa, now include substantial amounts of grain in their diets (Kerven 1987a, 1987b; Majubwa, 1987; Grandin, 1987). The transition from a diet completely dependent on dairy products among different communities in southern and eastern Africa becomes inevitable as pastoralists pass through various phases of pastoralism to settled mixed farming agricultural systems as illustrated in Table 29.

In Tanzania, an analysis of the distribution of the per capita milk supply by regions showed from the Livestock and Human Population Census 1978, that 5 out of 17 administrative regions had per capita milk (consumption) supply of less than 5 kg, while only four regions had consumption figures above 40 kg (112 ml/day) (Mpelumbe et al 1978, Kurwijila, 1988).

While these general figures of milk availability show very low milk supply levels and wide regional variations - a fact that is true also for most countries within southern and eastern Africa - pockets of high milk consumption among pastoralists and agro-pastoralists do exist.

These diets will benefit from the addition of grains and legumes to supply energy and part of the protein while those diets of non-pastoralists which are predominantly of cereal and starchy foods (Table 29) stand to gain by the addition of highly nutritious dairy products. This strategy can achieve both goals as milk released from the pastoral diet can be processed in situ and sold or exchanged for grains as is frequently done between cattle-owning and non cattle-owning households in agro-pastoral and mixed farming communities.

Table 29. Changing role of milk in the diet in relation to transition from pastoralism to settled mixed farming.

Cattle/ person (head)	Community	Country	Degree of pastoralism	Level of milk in diet	Level of grains/ legume in diet
18.0	Barbaig	Central Tanzania	PURE PASTORALISTS[1]	VERY HIGH	LOW
17.5	Samburu	Kenya			
15.0	Maasai	Tanzania			
9.0	Rendille	Northern Kenya			
6.5	Borana Galla	Northern Kenya			
6.0	Kenya Maasai	Southern Kenya			
4.0	Karamojong	Uganda	PASTORALISTS [2]	HIGH	MODERATE
3.7	Jie	Uganda			
3.6	Dodoth	Uganda			

3.0	Pokot	Kenya			
2.0	Kipsigis	Kenya			
1.7	Meru	Kenya	AGROPASTORALISTS[3]	MODERATE	HIGH
1.4	Teso	Uganda			
1.3		Giriama,			
		Kitui, Kamba Kenya			
1.2	Turu	Tanzania			
1.1	Kamba	Machakos			
0.5	Kikuyu	Kenya	FARMERS	LOW	VERY HIGH
0.5	Nyaktusa	Tanzania			
0.5	Haya	Tanzania			
0.2	Luguru	Tanzania			
0.2	Ngoni	Tanzania			

Adapted from Schneider (1984) and expanded by Kurwijila (1989).

(1) Agriculture lacking or insignificant

(2) Agriculture important in varying degrees

(3) Agriculture important.

2. SOUTHERN AND EASTERN AFRICA - ETHIOPIA.

There are various reports dealing with human nutrition in Ethiopia. However, the importance of traditional milk products in the diet of the people, especially those of the pastoralists and agro-

pastoralists, is not given the required attention.

The Ethiopian diet as a whole, is rich in carbohydrates but poor in proteins, fats and vitamins. The annual estimated consumption of 19 to 30 kg per head is much below the 62.5 kg per capita given by the Food and Agricultural Organization of the United Nations (FAO) as the average milk intake to be maintained for a balanced diet (FAO, 1974–1977). The nutritional problem differs from region to region and likewise from season to season. In the highlands, with a crop-livestock farming system, the number of milking cows per household does not exceed 1.5. They are local zebu with low milk production and the milk off-take for home consumption is about 1 to 3 litres per day, depending upon the season and stage of lactation. Excepting for calves and children, the nutritional aspect of milk is not given much importance.

On the other hand, in the pastoral and agro-pastoral areas milk and milk products play an important role in the diet of the people. Amongst these cattle herders, milk and cereal (maize and sorghum) form the basic diet. Where as in the highlands, cereals and legumes are the important food commodities. During the dry season, when milk production is at its lowest, the pastoralists suffer from malnutrition. On the whole, it can be concluded that the nutritional importance of milk and milk products in the diet of the nation can not be over-stated.

3. WEST AFRICA - MALI.

In general, the principal food items are cereals (millet and rice), milk and meat. The daily milk consumption pattern varies from region to region and from season to season. There are differences also between children and adults, males and females and the various social classes (Wagenaar-Brouwer, 1986). According to the World Bank (1983 Ann. 24), the Malians on average are only provided with 85 per cent of their calorie requirements. The pastoralists, where milk forms the greater portion of their diet, have poorer nutritional status as compared

to the agro-pastoralist whose basic diet is grains (Wagenaar-Brouwer, 1986). According to some estimates, the average annual consumption per capita is about 18 kg (liquid milk equivalent) over the whole country. This amount is about one third of what FAO recommends as the per capita average milk consumption to be maintained for a balanced diet (ILCA Bulletin, No. 4 1979).

4. SOUTHCONE COUNTRIES OFLATIN AMERICA.

According to the amount of milk destined for use in traditional milk products and information on raw milk marketing (Table 16) national milk consumption per capita very much depends on the traditional dairy product and the amount of raw milk sold direct to the consumer.

In Chile for example, from the 40 per cent (around 400 million litres) of milk which remains at the farm it is estimated that 10 per cent (40 million litres) go to feed the calves, to be used by the family and normal losses at the farm. Around 30 per cent of total milk production is destined for the preparation of traditional dairy products and to be sold directly to the consumer. Consequently traditional dairy products contributes around 30 per cent of the milk consumption average coming from national milk production.

On the other hand, in the case of Brazil almost half of its milk consumption derived from the national production comes from traditional dairy products.

In other countries such as Bolivia, Peru and Paraguay most of milk produced is used to make traditional dairy products. Therefore the traditional milk product sector is the main contributor to the milk consumption of those countries considering only their own milk production, that is, not taking into account imported milk. The precise contribution of traditional milk products is not known because there have been no studies or available statistics about this sector in most

of the countries.

However, from experience we know that traditional dairy products do have a great nutritional importance in the diet of those countries. Generally speaking, the dietary advantages of traditional milk products are the following:

a. **Traditional products satisfy the consumption habits of countries throughout the region. That means that most of the population enjoy consuming milk through those products, even though sometimes they don't like milk itself. In that way nutritional requirements such as calcium, protein etc., are satisfied,**

b. **The rural population and that of the nearest towns have a good supply of dairy products, normally at lower prices (at the farm) than the dairy products of industrial processing. Normally these populations do not have much opportunity to consume industrial products due to supply and cost problems,**

c. **For people who have good access to the industrial dairy products (i.e. people in the cities) the availability of traditional dairy products allow them to have more varieties of dairy products so that they consume milk through those products too in a more enjoyable way, so increasing their total milk consumption,**

d. **Traditional dairy products do not reduce the nutritive characteristics of natural milk. Most of those products are made from raw milk so there are no losses of milk nutrients because of the processing. In addition for most of them, nutrient concentration takes place during processing (e.g. cheese varieties, sweetened condensed milk, etc.) so they normally have higher nutritive values than fluid milk,**

e. **The manner of consumption of those products is very traditional and they are an important**

part of the normal diet of a country. They are part of traditional dishes and some of those are normally included at certain meals, for example, in Paraguay, soup is almost a daily part of lunch and dinner meals and cheeses are added to it. Traditional dairy products are included in the eating habits throughout the region.

Semi-hard cheese types are usually consumed at breakfast and tea time with a piece of bread or cracker biscuits. They are also consumed at lunch or dinner time together with some Italian dishes and traditional soups and finally they may be used for special cocktails with some wine and fried potatoes, etc.

Fresh cheese is consumed at breakfast and tea time in the same way as semi-hard cheeses but at lunch too it may be eaten with some special salads.

Sweetened condensed milk is consumed at breakfast and tea time in place of marmalade or inside tarts, cakes, biscuits etc.

So it does not require any special publicity campaign to increase milk consumption through the use of those products. It is only necessary to have them available at a reasonable price to have them consumed by most of the country's population whose diet is deficient in milk nutrients.

Nevertheless, traditional dairy products at the moment have some problems directly connected with their general poor microbiological quality.

In this respect, in general there is a consumption risk for those products (e.g. cheese) for the main population (very young and old people), since they are made mainly from raw milk, without heat treatment and of poor bacteriological quality. Fortunately, some products do not have these problems e.g. sweetened condensed milk which is heat treated for a long time to evaporate off the required amount of water.

In general there are no precise statistics on the outbreak of food poisoning and other illnesses related to food consumption. Many people know by experience the risk involved in the consumption of dairy products made from raw milk.

Another problem which could affect milk consumption is related to the absence of standardization of those products and at the moment people are asking for the best quality in food and particularly uniformity of each product variety.

The main problems related to the nutritional aspects of traditional dairy products are the consequence of faults in milk production, dairy processing, transport and general management.

5. MIDDLE EAST - SYRIA.

Milk is a well known product all over the country and forms with its products a very important component of the people's diet in most regions of Syria. At the breakfast especially, milk is considered one of the main dishes because every family used to have a few head of sheep, cows or goats to produce their own needs of milk and its products.

People in Syria consider milk as the most nearly perfect single food but its great nutritional importance lies probably in the ability of the consumer to mix milk with other foodstuffs and its ability to improve a mixed diet.

The nutritional importance of milk in the national diet is due mainly to its contribution of high animal protein, its exceptional richness in calcium and its generous supply of vitamin A and of riboflavin and other members of the vitamin B complex.

Also, the chief importance of milk and its products from a nutritional point of view lies in its

great contribution of calories and the fat soluble vitamins, as well as supplying a considerable part of the daily needs of people for vitamin C.

Cream (koshtah) has been considered as the most valuable part of milk due to its content of fat, for use in different types of food dishes, especially sweet dishes such as knafch and katayef, as well as being the raw material for producing butter (zobdeh) and ghee (samneh).

Butter (zobdeh) is very important in the national diet because the people eat it either as it is with jams or sweet food or as ghee or butter oil for cooking. Ghee is used only for cooking, more specifically in frying meats or vegetables.

Yoghurt (laban) or drained yoghurt (labaneh), are very important foodstuffs, especially yoghurt when it is used as a refreshing drink in summer time when weather gets hot. It is more important for patients who suffer from stomach disorders or pains.

Cheese as well are considered a very important part of the daily diet in the country because it contains a very high level of nutrients, vitamins and minerals such as calcium and also because of its ability to keep for a long time.

In the case of the minor Syrian milk products such as sheninah, shenglish (sorke) and keshkeh they also have very great nutritional importance in the national diet as breakfast dishes due to their content of energy, protein and minerals, and it is quite normal to see these products in every house in the cities or the villages.

6. ASIA

6.1 INDIA AND NEIGHBOURING COUNTRIES.

The composition of milk makes it an ideal balanced food for humans especially infants and its importance as a supplement to the average diet cannot be over emphasised. Traditionally in areas where milk production is abundant, milk and milk products are regularly consumed by almost all sections of the population. For example, the average Punjabi diet can compare well with some of the best diets in the world. However, the same cannot be said of the major sections of the population. Recognising the proper role that milk can play in the nutrition of the people, efforts are being made to increase milk production significantly. Supplementary feeding programmes for infants and expectant mothers, and school children, have always included milk powder as one of the ingredients.

There is hardly any major difference in the nutritive values of cow and buffalo milk except for the greater calorific value of buffalo milk due to its higher fat content.

Table 30. Nutritive value of cow and buffalo milk

	Biological value	True digestibility	Protein efficiency ratio
Cow	86.90	91.96	2.60
Buffalo	84.04	88.86	2.38

Although 46 per cent of the milk produced in the country is consumed as liquid milk and as such milk plays an important role in the national diet, there is considerable need and scope for increased consumption of milk. The expenditure elasticity of demand for milk is very high in India, 1.46 for the rural population and 1.3 for the urban population.

The daily allowances of nutrients for an Indian adult male (doing moderate work) recommended by the Indian Council of Medical Research are given below.

Table 31. Recommended intake of nutrients for the Indian male adult

Calories	2800
Proteins (g)	55
Calcium (g)	0.4–0.5
Iron (mg)	20
Vit. A:	
Retinol (ug)	750
- carotene (ug)	3000
Thiamine (mg)	1.4
Riboflavin (mg)	1.5
Nicotinic acid (mg)	19
Ascorbic acid (mg)	50
Folic acid (ug)	100
Vitamin B_{12} (ug)	1.0
Vitamin D (I.U.)	200

The average diet of the poorer sections of the population is deficient in several nutrients and most of these can be made up by supplementing the diet with milk. As against the recommended level of 200 ml of milk, the average per capita intake was 168 ml, in 1988. Except in the case of high and middle income groups it is less than the recommended levels. Milk plays a major role as a source of proteins in the average Indian diet contributing some 10 per cent of the protein intake. These data are indicative of the important part that milk plays in the nutrition of the population.

In India most milk is boiled before consumption. It is to this practice that the absence of milk-borne diseases in India is to be mainly attributed. Heating to first boil results in destroying

most of the organisms. Denaturation of proteins as well as its flocculation due to the neutralisation of the electric charges occurs to some extent on boiling milk. A partial precipitation of calcium salts and phosphates also occurs, the diffusible calcium being reduced from 26 per cent to 20 per cent.

Among the vitamins in milk, A is the most resistant, and C the most vulnerable to heat treatment. While hardly any vitamin A is destroyed by boiling, about 22 per cent of vitamin C is lost when milk is boiled. The loss of vitamin C is dependant both on the time of treatment and the exposure to light. A slight reduction in the thiamine (B1) content of milk occurs. Riboflavin (B2) is hardly affected. The availability of calcium and vitamins (except vitamin C) is not affected by boiling. Most of the enzymes of milk are destroyed during boiling and the digestibility of milk increases.

Hot milk is widely consumed before going to bed as a nightcap. The milk is usually flavoured with condiments such as almonds, cardamom, dry dates etc.

In the Indian households the life of milk is extended from 12 to 24 hrs by repeated boiling. The simplest way of preserving milk for human consumption in a tropical country is to allow it to sour with the aid of lactic cultures, checking putrefactive changes while giving to milk an acid taste which is particularly refreshing in a hot climate. The product thus achieved, dahi, is widely consumed in the country along with meals. The digestibility of milk constituents improves. Dahi can also be consumed by people who suffer from lactose intolerance. Almost every household in the country consumes dahi. Due to fermentation of milk a greater amount of phosphorus and calcium is made available to the digestive system by their precipitation in the lower intestines due to the acid condition induced by Lactobacillus sp.; and the consumption of sour milk also results in increased efficiency of the body to cope with a sudden influx of lactic acid in the system.

It is reported that when the food is supplemented with 250 g of dahi a day, the status of thiamine improves. Dahi also increases the pyruvic acid and the lactic acid among children on a typical poor rice diet. Thus, dahi in its different forms, lassi, kadhi, shrikhand etc. also contributes significantly to the average diet.

Makkhan and ghee contribute as much as one third of the fat in the Indian diet. Ghee is produced mainly for consumption directly as food and as an ingredient of food preparations including sweets. Over the centuries Indians have cultivated a liking for the aroma and flavour of ghee, and a preference for its use over vegetable oils, the other traditional cooking medium for the preparation of specific food items. The vegetarian habits of many Indians preclude from their diet hard animal fats such as tallow or lard used in the West and thus ghee forms an important source of fat in an otherwise vegetarian diet. For most uses, its wholesome flavour is the chief attraction. For table use it is served in melted form and mixed with rice or lightly smeared on chapatis. It is widely used for shallow frying and deep frying of food materials. Innumerable Indian sweetmeats based on cereals, milk solids, fruits and vegetables are cooked, by preference, in ghee. Buttermilk or lassi as described earlier is a by-product in the preparation of makkhan. It is estimated that about 55 kg of buttermilk is produced for every kg of ghee. While most of this is consumed by the villagers and their families, a good quantity is either given away or fed to cattle. The reason for this is the lack of market value for the product in rural parts. Buttermilk is rich in milk protein and calcium and forms a valuable human food.

Ghee and makkhan are important carriers of vitamins A, D, E & K. They also contain small amounts of essential fatty acids e.g. arachidonic and linoleic.

Considerable losses of Vitamin A and carotene occur during cooking, the loss of the latter being more rapid. Below 125°C Vitamin A is fairly stable but above this temperature it is rapidly

destroyed. It is found that 10–20 per cent of carotene is lost during the normal cooking operations.

6.2 HIMALAYAN REGION - NEPAL AND BHUTAN.

The very fact that malnutrition continues to increase throughout the world shows that policies have been inadequate. The supply of extra food to meet the needs of expanding populations is an enormous problem for the planners of agricultural development in the least developed nations of the world. In countries which have a predominantly agricultural economy the malnourished will normally be found among families of subsistence farmers and particularly landless labours who do not have enough milk and milk products in their diet. Milk and milk products are main sources of protein, fat, lactose and minerals. The traditional milk products are rich in fat and protein. Chhurpi which is solid hard casein, contains 81 per cent protein and 11 per cent fat. Sher or shergum in Nepal, has a high percentage of protein. The composition has never been analysed in Nepal and Bhutan. Sher or shergum is known as 'dartsi' in Bhutan. This product is widely used in curry, being cooked with green chilli and vegetables. If it is ripened it will have a more cheesy taste. In Bhutan, the ripened and smoked cheese which is packed in leather or calf skin bag has a similar nutritional value to non-traditional cheese. The most of the composition may match with non-traditional cheese. This type of cheese is called 'churtsi' in Bhutan. It is more expensive than other traditional milk products. Traditional butter and ghee have a great nutritional value. Both are used in cooking the foods. The normal traditional butter may contain on average 18–25 per cent moisture, 75.5 to 85.5 per cent fat; 1 to 1.5 per cent non-fatty acids and solids and 0.2 to 0.5 per cent oleic acid. The composition may differ according to the manufacturing process. Traditional butter and ghee are the main source of energy. Dahi and lassi, are also of great importance in the diet. In Nepal, dahi is consumed with rice and other suitable food. Lassi is drunk and is mainly used in the villages. Lassi contains more water than dahi. Dahi and lassi both contain fat, protein, lactose, ash,

calcium, phosphorus. So it has a great nutritional value. The average composition of khoa is given in Table 32.

Table 32. The average composition of khoa

Type of milk	moisture	fat	protein	lactose	ash	iron
		(percentage by weight)			(ppm)	
Cow	25.6	25.9	19.2	25.6	3.7	139
Buffalo	19.3	37.1	17.8	22.1	3.7	125

These figures indicate the important nutritional value of khoa.

The traditional products sar, malai and tar have a similar nutritional value to non-traditional cream but the protein content may be greater.

VII ORGANIZATION OF MARKETING

1. SOUTHERN AND EASTERN AFRICA - GENERAL.

The fact that only a small fraction of the milk produced in southern and eastern Africa is marketed by commercial enterprises implies that nearly all traditionally produced dairy products are marketed through traditional, informal marketing channels.

Most of the traditional dairy products are marketed through inter-household sales and exchange, rural trading centres and the common weekly or bi-weekly rural market days. In the majority of cases the women who process the milk are also the ones involved in marketing the dairy produce with occasional assistance from other female members of the family or young boys.

The prices received on sale of the dairy produce represent both the producer and retail (market) value of the product with no intermediate marketing agents involved. This simple marketing channel is of the lowest cost possible and does to a large extent provide maximum returns to the farmer under those particular situations. For example the return realised from the sale of a kilogram of buttermilk will fluctuate throughout the year depending on the change in the terms of trade of dairy products compared to food grains etc. (Kerven, 1987b). It has been stated elsewhere (Mbogoh, 1984) that milk is marketed mostly as sour milk or processed milk products such as butter, ghee or cheese. Except for ghee the other dairy products are usually of limited shelf-life and this tends to depress prices at times of plentiful supply of milk i.e. in the rainy season.

To improve the bargaining power of the traditional milk producer processors, products with a longer shelf life such as ghee should be encouraged. The production of buttermilk in the process of churning of sour milk to produce butter used in ghee preparation creates a bulky by-product of rather limited commercial value. This brings about buttermilk disposal problems after the family's needs have been satisfied. Production of cottage cheese from sour milk as is done in Ethiopia (O'Mahony and Bekele, 1985) is an option which might improve the marketing of rural dairy produce. Improvements in the shelf-life of the sour curd cheese may be achieved through pasteurization (cooking of the curd) as was suggested by Brumby and Gryseels (1984). However we need to be aware of the fact that apart from Ethiopia, there is no country within southern and eastern Africa where cheese or cheese-like products are made. This

implies that the introduction of such new technologies in the traditional dairy sector will be difficult to achieve at the household level for purely cultural reasons. It might be easier to introduce new products and technology if the level of milk processing is elevated from the household level to the community or village level. It is conceivable that rural milk producers will be willing to sell milk to a rural dairy so long as they will not have to bear individually, the cost and uncertainties of a new product and technology. Such a development appears to have taken root in various parts of Sudan where it is reported (Osman, 1987; Kerven 1987a) that merchants who have set up rural cheese dairies buy milk from pastoralists and convert it to cheese (gibna bayda) which they readily sell in the cities. Such an approach will require appropriate changes in existing monopolistic government regulations which invariably limit the right to purchase and process milk to established public or private dairy commercial enterprises.

2. SOUTHERN AND EASTERN AFRICA - ETHIOPIA.

In talking about marketing of milk and milk products in Ethiopia, we have to look at three broad categories of producers. The intra-urban, peri-urban large scale producers and rural area peasant producers.

The intra-urban and peri-urban producers have different options for disposal of their products. They can sell direct to consumers, to a processing plant (in Addis Abbaba and Asmara), to grocery shops, restaurants and bars. In the case or rural peasant producers, who are about 85 per cent of all producers, they can market only butter and that is marketed in local markets. The itinerant trader collects the butter in local markets and sells the bulk to big butter dealers or directly to consumers. This also applies to cottage cheese sold in local markets accessible by road.

3. WEST AFRICA - MALI.

Most of the output of dairy products in the traditional livestock production system is consumed by the producer's family. The marketing of residual milk and milk products is done in the local markets.

The capital city, Bamako, is supplied with milk and milk products by ULB, as well as by producers and traders. Fresh milk and home-processed sour milk (lait caille) and butter are marketed by producers, pedlars and retailers.

Itinerant traders collect milk from rural areas. The house to house collection is bulked in large containers and is transported by rail to Bamako. Adjacent to the Bamako railway station there is a big milk and milk products market. The traders are all women. The sour milk brought by rail is sold to the women traders. The women process some of the sour milk into butter and ghee and the remaining sour milk is sold to consumers and to retailers. The retailers are generally women who make a house-to-house call and sell the sour milk to consumers. The women at the market sometimes add reconstituted milk powder to buttermilk to increase the volume.

Hawkers on bicycle or motor bicycle collect milk from producers and sell it at the railway station market or directly to consumers by a house-to-house call.

Wives of producers collect milk, fresh and sour, from the surrounding producers and add it to their own production. They dispose of the milk by selling fresh milk to the ULB and with the remainder produce butter and ghee and sell the resulting products direct to consumers.

4. SOUTHCONE COUNTRIES OF LATIN AMERICA.

Small dairy producers sell their products through several channels getting different prices for

them depending on the individual system.

The most common one is to sell the products at the place of production. This is the most informal system which consists of people coming to buy traditional dairy products directly from the farmer or the traditional processing unit. In this system consumers and producers win because there are no middlemen in between. Probably, through this method the highest incomes could be obtained by the processors but usually, they require another sort of selling system because demand is not enough for the high production volumes, particularly in summer time.

The open market is another normal way used to sell traditional dairy products especially for non-authorized processing units. Sales may be made through middlemen or directly by the farmer. However, second quality product made at medium-sized processing units or authorized units are also sold in this way, using fancy names for those products in order that consumers do not identify bad products with the main trademarks. Prices obtained through this system are not so high, but at the open market big volumes of product can be sold.

There is also a system in which products are offered door-to-door by the salesman using a little delivery car so that housewives may buy milk products at their own home in a comfortable way. This method is used sometimes by the farmers themselves (as for selling raw milk) as well as by middlemen.

In the case of dairy processing cooperatives they normally have their own marketing. Probably, this is the only organized system and they have special sales places at the farm itself or at the main market in the city to sell their total production. In that way, farmers manage milk production, processing and even marketing of the dairy products in an organized system getting the highest incomes from the whole agricultural activity.

Besides those special marketing systems for traditional dairy products, the authorized processing units also sell their production in the main established markets of each country through supermarkets or similar retailing outlets e.g. farm chanco cheese is sold in the main supermarkets in Santiago, Chile. It is also sold by all the other systems mentioned above.

Of all the systems mentioned, selling through supermarkets and hypermarkets are the most difficult ones for traditional dairy products due to these markets usually having very efficient quality control of the products. Only good quality traditional products are accepted for sale. Provided quality requirements are met the prices are relatively good for farmers and the product becomes very famous, obtaining an important prestige value.

5. MIDDLE EAST - SYRIA.

The milk and its products produced in Syria in the governmental factories, are all sent to the general organization for retail trade which belongs to the Ministry of Supply and has a great number of supermarkets for selling different products directly to the consumers.

Some dairy plants have private agents for selling their products to the consumers. These agents are paid mainly by means of a special commission from the total amount of different products sold or the agents are given a special discount to allow marginal profit.

Milk and its products produced in the private sector are either sold directly to the consumers or in most cases through buyers (middlemen) who buy from the private farms in the villages under special price and sell in the markets around the cities adding a profit to that price.

Some private farms have contracts with the dairy plants to send these factories their milk. Most small holders sell their milk directly to the consumers.

6. ASIA

6.1 INDIA AND NEIGHBOURING COUNTRIES.

Marketing of the indigenous dairy products is as traditional as are the products. Halwais, the traditional sweetmeat sellers, produce and sell these products in all urban and semi-urban areas of the region. Halwais have prospered over the years as the products have high margins of profits.

The festival season (October - November) sales in many areas account for 30–40 per cent of the annual sales of traditional milk-based sweets. Most sales are made across the counter for ready cash.

Kulfi (ice cream) is usually sold from door to door by hawkers and some manufacturers also offer kulfi as a part of their wide range of ice creams.

Ghee is usually marketed in the traditional markets (mandies) by those who collect it from the villages and refine it further to remove all moisture. From the mandies, it goes to retail outlets. Ghee is usually branded by large traders. Large ghee mandies exist in Hathras, Khurja, Porbandar, Guntur and Erode. Jodhpur is probably the largest ghee trading centre in India. Some manufacturers now advertise ghee on the national television network. Organised dairies brands of ghee now fetch a good price as the quality is considered to be guaranteed.

Expanding markets. Some of the traditional halwais have more than one outlet in a city. Some have started canning rasogollas and gulabjamuns.

Bikaner in the west has emerged as a large custom processing and manufacturing centre for rasogollas. Halwais in Bikaner execute large orders and provide custom labelling for canned

rasogollas which are manufactured in the traditional way but do not reach the quality of the traditional product.

Modernisation of marketing efforts. The most modern plant manufacturing traditional dairy products is the Sugam cooperative dairy at Baroda marketing its products through a large network of 150 retail outlets in the city. The Sugam Dairy uses the traditional grocery/ general stores that have a refrigerator to market its products. The product range includes shrikhand, gulabjamuns, peda and lassi apart from flavoured milks. The dairy has the highest turnover of a single unit marketing traditional dairy products. Other dairies are active in marketing traditional milk products.

6.2 HIMALAYAN REGION - NEPAL AND BHUTAN.

In Nepal, except for the alpine regions, dairy farming and selling milk products is only a subsidiary occupation of the farmers.

Milk is marketed all over the country beginning with the smallest amount to a rural tea shop ending with the maximum amount in the Kathmandu valley. There are certain pockets in the mid-hills and alpine areas where milk is produced but it is not sold in liquid form because of the lack of a fluid milk market. In such cases the milk is normally converted into ghee for sale in the foothills etc.

In the high Himalayan region, before the cheese factories were established in the government sector the milk was converted either into traditional butter for sale in Tibet or into ghee for the Kathmandu market. At present where the cheese factories are operating the farmers sell their milk to cheese and butter factories.

At present, the marketing channel for traditional milk products for the remote and mid-hills area

farmers is making ghee and chhurpi continuously and storing them at the farmer's house for the whole milk production season, which also coincides with the main farming season.

From the main production areas, the ghee is transported into the nearest marketing centres, after the harvest of monsoon crops or at the beginning of the winter season. Accumulated ghee from the farms is brought into the market during the winter season in the tin containers each having 16 kg capacity. The farmers usually go down to the market in groups each having one of them as the leader of the group. In the market these leaders negotiate the price with the middlemen. In return for their services they get various facilities while they are in the market. The middlemen are financed by the ghee merchants who actually act as ghee processors, stockists and exporters. The merchants clarify the ghee by melting and decanting, after which they pack it in different sizes of tin containers and seal it. Then it is exported into the Indian market under the famous name of Nepal ghee.

The price is not fixed by any statutory body for the traditional milk products. It generally fluctuates from market to market. In any particular market the price is governed by the volume of inflow of ghee and the local available quantity or stock. They recover duties, costs of containers etc., together with some profit from the export price which is negotiated by the Nepalese exporters with their counterparts in the Indian market. Other traditional milk products besides these described above as well as chhurpi and traditional butter are traded by farmers and middlemen. Curd, khoa, sher or shergum are marketed locally by the farmers themselves. Sometimes middlemen also appear in the business. Khoa and sher are packed in leaves and sold in the market or through middlemen in the towns and cities.

In Bhutan, there are essentially two separate markets for milk and these have formed according to the religious and social structure of the country. Due to predominantly Bhuddhist communities of the northern two- thirds of the country about 90 per cent of the milk produced

is processed directly into natural lactic acid butter and cheese. Only a very small amount of fresh milk is fed to children or used in ordinary tea. The butter produced is mainly used in butter salt tea which is a mixture of tea, water, butter and salt.

Soft cheese is a very important component of the local diet. Butter and cheese also have an important place in religious ceremonies and considerable amounts of butter are used to fuel lamps in front of religious shrines.

The consumption of milk products in the Indian border areas in the southern third of the country tends to follow more closely the Hindu traditions with greater use of liquid milk rather than traditional milk products. All milk is boiled and it may be consumed directly as milk, in tea, or made into yoghurt which is an important component of the local diet. Ghee is produced from butter and used extensively in cooking. The ghee and butter are produced by traditional methods. So far there is no organized storage or distribution network for milk and milk products. Traditional butter and cheese have limited storage life and this restricts marketing. The trade in these traditional products is generally towards the regional urban centres and from there towards the larger centres such as Thimphu and Phuntsholing. In butter and cheese trading the farmer or his own family are becoming involved.

Recently the government of Bhutan established a mini dairy for liquid milk at Phuntsholing. This mini dairy plant will supply liquid milk to Phuntsholing and Thimphu. Similarly the government has initiated the organization of the marketing of cheese and butter with necessary procurement equipment, transportation and storage. A large quantity of chhurpi is exported to India and Nepal through the southern Bhutan borders. The demand for ghee and other products is increasing. The good quality ghee from Nepal and Bhutan can be exported to Pakistan, Sri Lanka, the Maldives, Bangladesh and even to other overseas countries, but it needs improvement in quality and in packaging.

VIII GENERAL DISCUSSION, SUMMARY AND CONCLUSIONS

1. SOUTHERN AND EASTERN AFRICA - GENERAL

Milk and milk animals. Within the countries of southern and eastern Africa, cattle provide about 70 per cent of the milk produced, followed by goats (15 per cent) and sheep (11 per cent). Except in Zimbabwe and Kenya, the bulk of cow milk is, still being produced from indigenous zebu cattle. Due to the partial suckling system used by indigenous stockmen and the general lack of record keeping, the milk yield potential of indigenous stock under existing pastoral management is not accurately known. The seasonality of milk supply reflects a general response to feed availability as influenced by rainfall regimes. This shows that slightly higher yields could be obtained through improved dry season feeding and better milking hygiene. There is a need to study the effect of such measures under field conditions and to evaluate their biological and economic response to milk yield. Such studies are necessary because, given the harsh environmental conditions under which they operate, traditional cattle herdsmen are not likely (at least in the foreseeable future) to accept replacing their stock with cross-bred or pure-bred dairy animals which require scientific feeding and are more susceptible to tropical diseases. Thus in most of the countries, traditional cattle milk and the traditional processing which go with it will in the foreseeable future, continue to be the focal point of dairy development.

As a source of milk, goats appear to be of greater potential than sheep. However, the harsh climatic conditions under which they thrive at the moment (arid and semi-arid areas) would not be conducive to the introduction of pure or cross-bred dairy goats. It is not immediately clear whether there exists enough variability among the indigenous stock to warrant adoption of "selection" as a suitable tool for genetic improvement. However the introduction of cross-bred dairy goats appears to be suitable in those intensively cultivated, highland areas where the population density is so high as not to permit the rearing of cattle (Madsen and Mtenga, 1988) or in situations where farmers are unable to pay the high price demanded for dairy heifers (Boor et al, 1987). Since butterfat is the main component of milk that is preserved and highly prized, cross breeding, selection and introduction of new breeds in the traditional sector should pay due attention to the effect of those measures on milk solids concentration and fat in particular.

Level of processing. As long as traditional stock of low milk production potential continue to be the major source of milk for the rural peoples of the Southern and Eastern African region, traditional milk processing will continue to be a household activity revolving around natural fermentation of milk, traditional butter churning methods (which are appropriate to the small quantities of milk processed) and ghee preparation. Production of cottage cheese from the sour buttermilk is, with the exception of Ethiopia, generally not done. While improvements to existing household level technologies may be made (O'Mahony and Bekele, 1985), the introduction of new and more efficient milk processing techniques, equipment (centrifugal milk separators, wooden/metal butter churns) and products (boiled curd cheese) will require the setting up of milk processing units at the village (community) level. Such village-based dairy processing units will enable more economic processing of larger quantities of milk and will be more in line with the historical role of dairy creameries in the process of the development of the dairy industry in developed countries. Such a strategy is being applied in Ethiopia with some success (O'Mahony and Peters, 1987) and is thus worth emulating in the other countries

after taking into account the peculiar cultural conditions of each community.

Traditional milk processing techniques. Naturally-fermented milk is the basis of traditional milk processing in Africa. In most African societies, special processing methods involving the application of wood smoke have evolved resulting in products with unique flavour and extended shelf life at ambient temperatures. Kurwijila (1989) points out that the practice is so widespread that it warrants much closer attention than has hitherto been given to it and that unlike the smoking of fish and meat products (FAO/WHO, 1975) there have been no studies on traditional smoking of milk.

In Africa a variety of plants ranging from grasses, shrubs, legumes and hardwoods such as Olea africana are used in the smoking of milk (see Table 13). It would be desirable to identify and characterise some of the common plants used and the smoke derived thereof as a first step towards understanding the possible effects of smoke application in milk.

The interaction of woodsmoke constituents with milk components (especially proteins) under the conditions of traditional smoking techniques need to be investigated with a view to establishing the effect of these interactions on the nutritive value of milk, on the bacterial flora and whether the improvement in shelf-life of traditional fermented milk is due to selective bacteriostasis or bactericidal effects. Information so obtained could be used:-

a. **To identify suitable and unsuitable wood types and conditions of pyrolysis,**

b. **To identify the benefits or otherwise of the smoke application practices and give appropriate recommendations,**

c. **To modify the smoking technique to for example, the use of standard smoke condensates from approved woodtypes in the industrial production of sour milk products bearing**

traditional flavour and taste where this is more desirable than conventional sour milk products.

Butter and ghee. When the processing of milk involves 2 to 20 litres of milk only, then extraction of fat from milk through churning of fermented milk is, under prevailing conditions in the rural areas, both practical and most appropriate. The efficiency of fat recovery may be improved through churning at temperatures slightly below 20°C (traditionally strived for through churning in the early morning hours) or by attachment of internal agitators to traditional vessels (O'Mahony and Bekele, 1985).

The overall efficiency in fat extraction can only be effected through the introduction of centrifugal separators and wood/metal churns of bigger capacity and better design than the traditional clay pot. Because of the high investment costs involved this strategy calls for establishment of village dairy centres to be operated on a co-operative basis or by individual entrepreneurs willing to pay pastoralists a good price for their surplus milk.

Cheese and milk curds. Although cheese is not a common dairy product in traditional African dairy processing, its introduction where local circumstances permit is highly desirable. It improves the preservation of valuable milk solids (skim milk) after the extraction of fat. Where quality can be guaranteed, there are a few successful cheese making ventures in the region to assure anyone that there exists enough local demand to justify such undertakings. O'Mahony and Peters (1987) have published manufacturing procedures for a number of cheese varieties considered most suitable to the African situations. A pasta filata type of cheese has proved to be a suitable cheese variety under village conditions in one FAO sponsored project in Tanzania. One of the main limitations of adoption of rennet cheese types is the lack of such critical ingredients as rennet and starter cultures. It would be desirable if some laboratories at academic and research institutions could undertake pioneer work in extraction of milk

coagulating enzymes from plant, microbial and animal sources as well as the maintenance of dairy culture type collections to service the local demand for these items.

2. SOUTHERN AND EASTERN AFRICA - ETHIOPIA.

In the case of Ethiopia, the traditional technology for milk processing and the products have remained static owing to the lack of improved production and marketing organization. In recent years, in intra-urban and peri-urban areas, dairying has shown an appreciable tendency towards development. This is due to better market outlets for their products, availability of supplementary feed, better breeds, better animal health services and easy access to technical advise. Pricing policy, poor feed resources, low productivity of the local animals, poor animal health services, poor marketing organization, absence of technical advise and training, have contributed to the existing conditions of production and processing.

If milk production is to increase, a dairy development package, including all the parameters of clean milk production along with processing pricing policy and marketing infrastructure must be prepared and implemented. This can be a long term projection as it requires a large investment. Short and medium term development projections such as small centralized processing units, clean milk production, introduction of appropriate forage crops, improvement of shelf life of traditional products, animals health services, marketing infrastructures and others that strengthen the dairy sector must be acted upon.

For a long time to come, traditional milk products have a role to play in the economy of the producers. Thus, they are important farm commodities.

3. WEST AFRICA - MALI.

In order to improve the national diet of the people and to curtail foreign exchange expenditure

on milk and milk products, milk production, collection and marketing must be developed. During the high production season, there seems to be surplus milk at the production centres. The surplus milk is not efficiently utilized. If the surplus milk during this season could be collected and converted into butter oil and skim milk powder these products could be utilized for reconstitution during the low production season. Prior to any investment, the availability of milk, the reliability of the source and economic justification must be worked out.

Milking conditions and hygiene can be improved through the supply of clean water and training of the producers in clean milk production. This can only be achieved when there is a market for milk and when prices for clean milk are higher or more attractive to the producer than what they would get with the traditional production practices.

In sour milk technology, cream separation is not practiced. Butter is produced by churning the sour whole milk. This requires a larger churn capacity, because of the large volume of sour milk compared to cream. Otherwise, churning in small portions with the small traditional churns requires a long time. In rural areas the fresh milk market is not developed. As a result, farm income from dairy products for rural producers can only be generated through the sale of traditional products in rural markets. After a feasibility study, in the high producing areas, village processing units can be established. If found feasible, village processing units may be established in areas where milk marketing facilities are not available or likely to be made available in the near future.

The industrial level of processing is done by one plant in Bamako, that is the ULB. Presently, ULB is supplied with about 80 per cent of its milk requirements by means of imported milk powder, either purchased or through food aid. The rest, about 20 per cent is locally supplied fresh milk. This is due to the fact that road networks between the production centres and the plant, seasonal fluctuations in milk supply and collection and cooling facilities at the

production centres and a refrigerated tanker for hauling milk to the plant are not available.

Thus, in order to strengthen the supply side, animal feed, water, selection and breeding and animal health services must be established and those that exist must be strengthened. Along side this, collection and haulage to the processing centre must be developed.

For a long time to come the traditional milk products will be produced. Unless milk preservation techniques and fresh milk markets are developed, owing to the short shelf life of milk, the sour milk technology is the only means of disposal of milk.

4. SOUTHCONE COUNTRIES OF LATIN AMERICA.

From the information presented above on traditional dairy products it may be concluded that the agricultural sector has a tremendous importance for each of the southcone countries, but there are still many difficulties. Nevertheless, most of those troubles have originated from several main weak points which could be summarised as follows:-

1. **Milk production deficiencies. According to specific studies and experts' opinions, the main problem in milk production in all the countries of Latin America, especially in the small producers group which are the most numerous, is the unsuitable systems for feeding cows. This problem is due to inadequate general management of the farm business and limited economic resources of the farmers. Nevertheless, the general low educational level of farmers and particularly the farmer's poor knowledge of specific matters such as dairy production, cow feeding, economic farm management, etc. have contributed to the problem as well. A low yield average (kg of milk/cow/year) is found in all of the countries; only the Argentinian yield is close to the European average but even this could be improved.**

2. **Poor quality of raw milk and traditional dairy product. For the same reasons as are mentioned above, the quality of milk is poor. Cows are not usually subject to veterinary control, so many important illnesses such as tuberculosis, brucellosis, etc. could be transmitted through the milk to human beings. In addition mastitis is also found in cows in southcone countries. Consequently, traditional products which normally use raw milk have a poor quality, both from the point of view of the risk to human health and also in respect of the short shelf-life of the end product. Finally, a large amount of milk is lost due to rapid spoilage or high microbiological contamination.**

   Because of this, traditional dairy products are less popular and suffering loss of prestige day by day.

3. **Workers skills are very poor. In the southcone countries, the educational level of workers in general is too low and most of them have never attended a specific course in milk production or processing. So they do not have technical knowledge to develop or to improve milking practices or processing steps in order to obtain higher quality of milk and traditional products made from it.**

4. **Support for the traditional milk product sectors is insufficient. National and international aid to the dairy sector has traditionally been turned over to the industrial dairy sector of southcone countries. This happens because they are an influential sector. Big milk producers are located close to them and the establishment of a dairy factory is achieved quickly. To develop a big sector of small producers and associated traditional dairy processing a lot of work and many years are needed to obtain even a very small advance. However, advances of small farmers means development over all the agricultural sector and the country as well.**

Looking for some suitable and practical solutions for these shortcomings there is an urgent need to carry out a detailed study of the behaviour of this sector in each country. At the moment it is almost impossible to obtain the information required to design special national policies in order to help in the development of the sector.

Nevertheless there are some measures which can be taken to overcome the problems of this sector in southcone countries of South America. These should include some special projects with national and international financial support in which the following aspects would be worthwhile to include:-

1. **Help for the development of an organisation of small milk producers all over the country and the formation of collecting centres or small or medium-sized processing units to make traditional dairy products and encourage distribution and marketing of these products.**

2. **To create a properly functioning chain of markets especially for traditional milk products to which all the small dairy units could send their products.**

3. **To create a technical specialized organisation to help farmers and dairy processors, through the provision of special courses at an applied and practical level and to provide technical assistance to them at their own place of production.**

4. **To help farmers to be more efficient in quantitative (yield) and quality aspects of milk production probably through the training of dairy workers with self-teaching courses, T.V. courses, etc. and technical assistance to the dairy farm. Not only hygienic milk production, but also cow feeding matters, etc. should be included in this tuition. Farm organization, financial management, marketing aspects, etc. should be included in order to improve the general management of dairy farms and make the farms economically efficient.**

5. **It is necessary to have practical courses in cheese production and processing methods for other dairy products to improve product quality and uniformity.**

6. **National economic policies should be encouraged by the Governments through the establishment of special credit, tax, etc. to this sector. Through suitable policies the organisation representing small producers could invest in milking equipment and dairy processing requirements for the small dairy sector.**

7. **Help to improve or develop national standards to regulate small processing units in respect of equipment, processing methods, marketing etc. in order to ensure the public health safety of traditional dairy products.**

The future of traditional dairy products looks as if it could be very promising if national government and international aid was given to this agricultural sector.

A good future for this sector can be seen, if small producers organizations are established and some economical and technical help is given to them to improve all the steps involved in their activities. The consequence of such assistance could be improved raw milk supply and dairy product quality and a change of consumers' opinion about health risks with those products resulting finally in high profits for the dairy producers and a supply of nutritious and safe dairy products for the national populations of these countries.

In considering improvements, one of the main problems is the limited information about this sector in every southcone country. General statistics about the traditional dairy sector and even the industrial one in many countries are only estimates. There are no statistics about traditional processing units in any country, even the exporter countries. There are only statistics about authorized cheesemakers in Chile, but not the total dairy processing units e.g.

producers of sweetened condensed milk and non-authorized cheesemakers are not included.

It is essential to evaluate this sector in each country in order to develop policies appropriate to the potential of each country.

5. MIDDLE EAST - SYRIA.

There are many limiting factors for the expansion and development of milk production from cows, sheep and goats. Sheep are considered as the main source of milk in Syria, and this source is concentrated in the steppe and the feed base there depends upon the climatic conditions. Unfortunately the steppe does not have the capacity to support the present number of sheep and consequently overgrazing has led to deterioration of the feed base in the steppe area, so the nutritive requirements for both maintenance and production cannot be met and this has lead to a decline in milk production.

Another factor limiting the expansion and development of milk production from sheep is the seasonally dictated need to move flocks in the steppe during the lactation period.

This in particular has very limiting implications for the collection and processing and storage of good quality milk and to a lesser extent for the quality of milk products.

In the dairy cattle sector, the national lactational average of milk production per cow is considered to be low in comparison with the average of the exotic cows. This is due to nutritional deficiencies for animals of this type because sometimes the country is deficient in feedstuffs supplies especially green fodder and protein feed. The genetic potential of the local cattle breeds limits milk production, so genetic improvement programmes should be carried out in order to increase the yields of these breeds.

The co-operative movement in the dairy sector does not have the proper structure to have the dynamic role needed to advance the dairy industry. All these factors affect the milk production from dairy cattle in Syria.

Regarding goats, until now they have been raised by the farmers who do cropping besides having a few animals (sheep and goats) and they do not give them the attention required so the amount of milk yields are very low. Government has no specialised centres for milk production from goats; this aspect should be given major attention in order to increase milk production.

The main limiting factor affecting production of milk and its products are price policies which have a negative impact on production, as result of which a great proportion of farmers or producers prefer to sell their own products in the markets rather than selling their milk to the governmental factories, for processing.

The administrative structure sometimes plays a negative role in this field.

Concerning milking conditions and hygiene, it has been mentioned that the main producer of milk is the private sector which contributes about 98 per cent of the total milk supply. The milk and its products produced by the private sector are sold in the markets without any sanitary control and do not conform to any specific standards of hygiene and quality. The private producers use very simple methods for milk production and do not follow the hygienic procedures. Milk quality in terms of bacterial contamination is not considered important in the milk market. There is a great demand for milk regardless of its quality and therefore there is little incentive to improve quality.

Government and private factories use very simple methods to process milk into different products. Packaging is considered a limiting factor for milk processing.

Extension services are not playing their planned role regarding milk processing extension and they should teach the farmers how to process and sell their milk suply economically. Also, the country is lacking in laws related to the composition and hygiene of milk. These aspects affect the milk processing sector.

Technologies followed for the production of yoghurt, cheese and ghee are considered to be traditional at the level of villages and individual herds and flocks.

To improve the dairy industry in Syria the following could be implemented:-

1. **The expansion of milk production from dairy cows must be based on promotion of forage production for both private and governmental sectors and/or the use of locally-produced industrial by-products and agricultural residues in animal feeding.**

2. **Improvement of genetic resources of the local cattle breeds by selection and by up-grading these breeds by crossing with high yielding exotic cattle.**

3. **Establishment of specialized goat milk farms for governmental and private sectors.**

4. **Expansion and promotion of the extension services to teach the farmers about the dairy industry, regarding production, processing and marketing.**

5. **Grazing management in the steppe area, and support for the flocks there from feed produced in the governmental farms in order to preserve the feed base in the steppe.**

6. **Establishment of sedentary flocks (by settled bedouins) in the steppe area in order to facilitate the distribution of feedstuffs and the collection of milk.**

7. **Developing quality control measures and state legislation and laws for the quality and sanitary control of milk and its products.**

8. **Developing of village processing units for production of different milk products with low unit costs and using cheap packaging.**

9. **Marketing should be studied in order to identify realistic solutions for the aspects related to milk products marketing.**

10. **Improving the hygienic milk production practices of the nomadic people in the steppe through training at the basic level and the contribution of extension services in their training.**

11. **Refrigerated mobile units and the use of the solar energy coolers for milk storage and processing under steppe conditions in order to ensure high quality products.**

12. **Promotion of an artificial insemination plan in Syria.**

13. **Animal health programmes involving different services such as vaccination, disease treatment by drenching, dipping and spraying with an integration of training of the farmers in the basic elements of the flock/herd health management.**

14. **Promotion of the co-operative movement's role in the planning and implementation, and servicing the farmers, to produce more milk.**

15. **Encouraging the private sector to establish more dairy farms by giving loans for the infrastructure needed for this purpose.**

The future for traditional milk products. The consumption of traditional milk products is increasing due to growth of the population, and to peoples' demand and their awareness of the nutritional importance of these products in their diet.

Traditional milk products will remain in the future but the technologies for producing them will change into modern technologies resulting in higher yield and better product quality.

6. ASIA

6.1 INDIA AND NEIGHBOURING COUNTRIES.

Strengths and weaknesses. The major strength of the traditional dairy product sector is the mass appeal of such a wide variety of products. The market for these products far exceeds the market for western dairy products like milk powder, table butter and cheese. The operating margins in traditional products are also much higher than those for the western dairy products as is evident from Table 33. It can be safely stated that the increased demand for these products by the consumers, presents a great opportunity for the dairyman in these countries.

Table 33. Raw material cost as a percentage of the sale price

Product	Raw material cost as percentage of sale price
Market milk (bulk vended)	90
Market milk (packaged)	80
Milk powder/butter	70
Paneer	65
Peda/burfi/kalakand	35
Rasogolla	33

Sandesh	39
Gulabjamun	34
Shrikhand	29

The major weakness of the sector is the lack of hygiene in the preparation and handling of traditional products and their short shelf-life. Ghee is an exception, where traditional ghee seems to have a longer shelf-life than the organised sector's ghee. The preparation and marketing of these products is generally done by the halwais and that limits the expansion of the sector.

There is a general lack of literature, data on production and marketing and standard specifications for production and quality control. The halwai's trade is generally looked down upon in the society and there is therefore no glamour attached to further work in that area. That limits the opportunities that are available to explore, modernise and expand the production and marketing of these products. Some of these products are very fragile and delicate to process and handle, their preparation requires a great deal of manual skills. The overall standards of hygiene and manual handling need to be improved. Lack of suitable packaging materials and techniques for the packaging of these products, is another constraint that needs to be overcome.

Modernisation of the traditional sector. The business opportunities provided by these products call for a thorough study of the sector with a view to exploit these opportunities for paying more to the milk producers and encourage increased milk production. It also provides a great opportunity for the marketing of hygienically prepared and properly packed products to a large population that has so far been used to unhygienically produced products.

The method of preparation of these products by the traditional methods needs to be studied

and well documented on a scientific basis. The technological parameters, the biochemical changes and the keeping quality of these products should be further researched, with a view to developing the unit processes required for the large scale manufacture of these products. Some of the food processing methods available in the developed countries can be usefully exploited to manufacture these products. Some process modifications, may however, become necessary.

The Bureau of Indian Standards has now worked out standard specifications for the quality of khoa, shrikhand, burfi, rasogollas and gulabjamuns. This is encouraging and the quality standards should be specified for all the important traditional products.

Research efforts need to be intensified for developing standard methods of processing, manufacturing and packaging these products on a large scale so that the dairy industry can benefit from the higher operating margins that these products provide.

Future for traditional dairy products. The high value that the consumers attach to these products is a guarantee that will ensure the future growth and modernisation of traditional dairy products. The many advances that dairy technology has made will provide the tools to further explore and improve upon the quality and shelf-life of these time-tested products. The advent of convenience foods and their increased acceptability in the region will further support the modernisation of this sector.

6.2 HIMALAYAN REGION - NEPAL AND BHUTAN.

There are practically no organized marketing centres for traditional milk products in these countries. The marketing channel is unorganized and without any rules and regulations. There may be some rules and regulations, but they are not applied.

In Nepal, the marketing channel for ghee is more or less organized. The role of different categories of personnel involved in ghee marketing is well defined already. There is however no control of quality of ghee. Similarly, with other traditional milk products. Khoa, chhana, panir, shergum and country butter have no quality control. The lack of any guarantee from the government of the quality of traditional products is the reason for a lower price of the products. In the traditional way, curd (dahi) is sold in an open earthenware pot. If this method of package is used to transport dahi over long distances then all kinds of atmospheric contamination may occur. Khoa and soft cheese are often left in a shop in open containers thereby attracting a lot of files. Traditional milk products are prepared under unhygienic conditions. Cleaning and washing of equipment and milking animals are seldom done. Hygienic conditions are poor in most of the stages involved, from milk production to the sale of final products.

There are many constraining factors in the production of traditional milk products. The main problems are listed as below:-

a. **lack of hygiene measures in milk production and in the preparation of traditional milk products.**

b. **Inadequate technical support services.**

c. **Marketing and distribution difficulties and lack of organisation.**

d. **Pricing policy.**

e. **Poor infrastructure.**

f. **Lack of funds.**

g. **Inadequate production of raw material in suitable areas and the fact that many of the farmers and animals are in scattered locations.**

Dairy development is essentially a process of collecting raw material and after adding value by processing, selling it to consumers at reasonable rates. While considering the development of traditional milk products in Nepal and Bhutan or the Himalayan area we have to take into account the demand and supply side of the products. With respect to demand the rate of increase in population and income should be considered. There is an effective and increasing demand for milk and milk products. Due to the perishable nature of the raw material, and the shortage of facilities new varieties of products cannot be introduced in the present conditions. Non-perishable versions of traditional products should be researched and introduced commercially.

In order to improve the quality of traditional milk products the following suggestions may be considered:-

1. **Training for hygienic milk production should be given to farmers at farm gate level.**
2. **Dairy Technical Support Services should be provided.**
3. **Marketing of traditional milk products should be channelised through identified institutions.**
4. **Improved breeds of animal should be introduced or given to farmers.**
5. **As many farmers live in scattered areas and under poor conditions, a cooperative society or small farmers' association should be formed to organise milk transport to markets.**

6. **The quality of products should be improved.**

7. **A package of policies is needed to harmonise the prices of various inputs.**

8. **A locally-relevant research and development plan with special attention to appropriate technology is needed.**

9. **Ghee grading, and specifications, should be fixed by establishing ghee refinery factories and laboratories to raise quality to export standards to third countries.**

10. **There may be many other varieties of traditional milk products undiscovered in the Himalayan areas. Therefore it is suggested that a team of experts from F.A.O. should be formed to make the further investigation of the traditional milk products more detailed in the Himalayan area particularly, Nepal, Tibet, Bhutan and the alpine region of India.**