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SUMMARY OF FINDINGS

INTRODUCTION

The Seminar on Sustainable Dairy-sector Development for Poverty Reduction, which was organized by the Asian Productivity Organization (APO) and hosted by the Government of Pakistan, was held at Faisalabad from 22 to 27 November 2004. On behalf of the Government of Pakistan, the National Productivity Organization of Pakistan and the University of Agriculture Faisalabad, implemented the program. Fifteen participants from 11 member countries and eight resource persons from Food and Agriculture Organization, Rome, India, Republic of Korea and Pakistan participated in the seminar.

The objectives of the seminar were: (a) to review recent developments in the dairy sector in member countries with particular focus on smallholder dairy farmers and rural areas; (b) to identify issues and constraints that resource-poor smallholders are facing; and (c) to discuss major challenges for raising productivity for the sustainable development of the dairy sector.

The seminar was held in four stages. In the *first stage* **resource papers** were presented on the core subjects of milk production, productivity enhancement, milk procurement, milk procurement organization, milk processing, product manufacture and marketing. The resource papers highlighted the latest developments in diverse areas that would help dairying in its totality and help to add value to the produce of the rural smallholder. In the *second stage* **country papers** were presented. These papers discussed the current scenario of dairy development under country specific conditions and state of the smallholder. Each of the presenters identified challenges and issues facing that country. Discussions held at the end of each of the sessions on resource paper and country paper helped in surfacing the problems and likely solutions. In the *third stage* the participants usefully applied a day to **visit the Pakistan countryside** to appreciate the systems prevalent in Pakistan for rural milk production, farming practices, procurement practices and small scale chilling of milk to extend its shelf life. The participants compared the systems prevalent in their home countries with the Pakistani farms. The last and *fourth stage* of the seminar was a **workshop** held in two parallel groups. The workshop was held to identify issues and problems in development of sustainable small-scale dairy sector in member countries; and to formulate strategies and strategic action plans to address those issues and problems.

The subjects covered by the resource papers were: (1) Sustainable Development of the Cottage Dairy-sector in Asia and the Pacific – Challenges and Opportunities; (2) Role of Small and Medium Enterprises (SMEs) in Sustainable Dairy Development; (3) Management of Dairy-animal Feeding for Better Productivity and Food Safety; (4) Management of Dairy-animal Breeding for Higher Productivity (Paper not available); (5) Small-scale Milk Collection, Processing and Marketing – FAO Activities; (6) Milk Production and Marketing Systems in Pakistan: Constraints and Opportunities (Paper not available); and (7) Cost-effective Technologies for Milk Preservation and Processing by Dairy SMEs.

Based on resource paper and country paper presentations, group discussions and other seminar deliberations, the participants identified issues and problems in the development of sustainable small-scale dairy-sector in the participating member countries and formulated strategic actions to address them, as summarized below:

Group A. Development of Sustainable Milk Production (Preharvest)

Issues/Problems	Strategies	Strategic action/Activity	Perceived Agency/ Organization
1. Availability of suitable genetic resources of dairy animals	1. Development of local breeds	1. Smallholder dairying in Asia should preferably be developed on upgradation of local breeds of dairy animals. The objectives and goals of breeding the animals and the strategies should be decided with regard to the national priorities.	1. Government department should decide the objectives of breeding policy.

	2. Conservation of genetic resources	2. There is need to set up system for record keeping of life cycle events/activities of dairy animals kept by the Smallholder so as to conserve and develop local genetic resources.	2. The execution of policy objectives should be facilitated by the government departments in participation with the farmers' organizations and the NGOs.
	3. Choice of local or exotic breed	3. Crossbreeding programs set up for higher milk production should be sustainable and restricted to non-descript animals. Indiscriminate crossbreeding of known and developed indigenous breeds must be avoided so as to protect and conserve the indigenous genetic resources.	
2. Inadequate availability of feed resources and nutritional management of dairy animals.	1. Adequate availability of quality feed resources throughout the year	1. For efficient milk production, the local feed resources should be used as the main feeding inputs.	Government departments, agricultural universities, research institutes, farmers' organizations and NGOs, etc.
	2. Appropriate technology for improving the quality of feed/fodder resources.	2. Technology and techniques are available and should be further improved to process and preserve fodder for future use. For example, local fodders and foliage when available in abundance can be preserved as hay and silage. Research and development should continue keeping in view the environmental issues to develop new feed resources.	
	3. Improvement of feed quality and feed production system	3. Strategy to cope up with the seasonal feed availability is developed with reference to specific agro-ecological zones and the technology be transferred to farmers.	
	4. Development of practical guidelines	4. Practical guidelines should be developed for feed resources management and feeding under different systems of dairy production.	
	5. Farming practices for sustainable dairy production	5. Different dairy production systems, e.g., animal-crop system, commercial animal production system, multiple species system, etc., need to be utilized for sustainable dairy production.	
3. General Management	1. Human resource management	1. Small scale farmers should be trained for animal care, housing, prophylaxis, prevention of mastitis, vaccination, de-worming, reproductive management (heat	Government departments, agricultural universities, research institutes, farmers'

		detection) & control of communicable diseases and resource utilization for improved productivity of safe milk.	organizations and NGOs, etc.
	2. Disease control and health management	2. There is need to develop and train village based persons as para-vets, technician, professional for animal production and health control for smallholder set up.	
	3. Waste management	3. Continued education of farmers and technicians is needed. Improved utilization of animal waste for fertilizer/compost, biogas, etc.	
4. Inadequate farmers' motivation, participation and lack of farmers' organizations.	1. Sensitization of farmers to build leadership and motivate them to improve their economic and social status through scientific management of animals, awareness of the advantages of self-help and co-operation.	1. Small scale farmers be sensitized and trained in: ➢ Resource utilization; ➢ Feeding management; ➢ Reproductive management; ➢ Disease prevention, e.g., mastitis, vaccination, deworming; ➢ Prevention and control of communicable diseases; ➢ Indiscriminate use of antibiotics and hormones and their harmful effects; ➢ Management of animal waste and its use as bio-fertilizer/biogas, etc.; ➢ Hygiene and sanitation and its importance in good quality milk production; ➢ Continued education/training of farmers is needed for sustainable dairy production.	Farmers' organizations, Government departments, agricultural universities, research institutes, and NGOs.
	2. Investment into Farmers' groups/ organizations; or co-operatives.	2. Farmers need to be organized into groups/cooperatives/associations for channeling of investment, training, improved utilization of resources and to protect their interests in overall milk production and postproduction activities.	

Group B. Development of Efficient Milk Purchase, Processing, Marketing, etc. (Postharvest)

Issues	Strategy	Strategic action/Activity	Perceived Agency/ Organization
1. Lack of market-oriented approach towards milk production and marketing	Educate farmers / farmers groups on market opportunities available for milk and dairy products	Awareness raising, market research to identify and quantify market opportunities	Government, Farmers' organizations, research organizations

2. Lack of assured payment of fair price for the milk produced by the small farmer	Organizing farmers into strong groups	Development of tailored milk payment system	Village level organization of farmers. Setting up of farmers' organizations should be facilitated by the government and NGOs
3. Linking the farmer to the market and reducing the post-production losses of milk	Reduction of post-production losses	1. Establishment of collection points 2. Adopt two times a day milk collection whenever feasible	District level Farmers organizations
4. Improving quality of milk and milk products	Set up standards for milk and milk products relevant to national needs based on principles in the Codex Alimentarius	1. Adopt cheap and traditional on-farm milk preservation methods 2. Use of Lactoperoxidase whenever feasible 3. Establish intermediate chilling system of milk for a cluster of villages 4. Develop and update national standards	Agency to be nominated by the national government on policy issues; Farmers' organizations and milk processing plants to take strategic actions
5. Transportation of milk from village farmers' organizations	Good rural road infrastructure for transporting raw milk	1. Construction of roads linking villages 2. Clustering of village milk producers into feasible milk routes 3. Setting up intermediate chilling center when transportation is more than five hours 4. Use suitable containers (e.g., food grade) for collection and transportation of milk	Government, district level organizations
6. Small Scale Processing of milk	Set up processing facility where long distance transportation is not advisable or feasible	Set up small-scale demonstration facility to process 1,000 to 1,500 liters of milk daily; Processing facility should be determined based exclusively on localized conditions of making market-oriented milk products and likeness of people targeted for marketing such products	District level farmers organizations to be funded by the government
7. Medium scale processing of milk	Establishment of medium plants where long distance transportation of milk is feasible and where procurement of milk is estimated to be 25000 liters per day.	Set up a plant of 100,000 liters per day capacity	District level farmers organizations to be funded by the government

8. Processing of milk in countries where extreme weather conditions affect the farmers adversely (for example Mongolia)	To purchase and preserve surplus milk during summer	Set up a milk powder plant with a capacity to produce 10 tons of milk powder daily	Provincial co-operatives. Funding by the government
9. Setting up Farmers' Organizations at village and district level.	Sensitization of farmers to activate them in helping them in improving their economic and social status through scientific management of milk production, procurement, processing, etc.	Spear head team for setting up of farmers' organizations at village and district levels	Government and/or NGO
10. Project planning	Project identification and preparation of report	Dairy sector review on project preparation	APO/FAO in consultation with countries
11. Project funding	Poverty reduction through dairy development	Submitting proposals by the respective countries and implementing agencies. APO and FAO to facilitate the governments	Asian Development Bank/World Bank/ other multilateral funding and donor agencies

CONCLUSIONS AND RECOMMENDATIONS OF THE SEMINAR

Whereas the above summary proceedings of the two groups of the workshop are meant for management and strategic implementation, the following conclusions and recommendations are for polity options and policy formulation. The participants have, therefore, concluded and recommended as follows:

For the National Governments

1) National governments may set up a national coordinating agency to lead sustainable development of small-scale dairy sector.
2) Smallholder dairying in Asia should preferably be based on local animal breeds and feed resources. The competent departments of the national government should define the goals and strategies of breeding and feeding programs. Crossbreeding with exotic breeds should be only on non-descript milk producing animals and indiscriminate crossbreeding of identified and established milk breeds should be avoided so as to protect and conserve the indigenous genetic resources.
3) All activities of milk production enhancement; milk purchase and procurement; milk products development, processing and marketing should be mobilized by the national government through the voluntary and democratically managed farmers' organizations. The government organizations may initially involve in setting up the farmers' organizations at village and district level, and in financing and installation of milk processing facilities. Eventually the government organizations be phased out and allow autonomy to the farmers' organizations in management.
4) Regional initiatives within Asia and the Pacific need to be developed to share on the experiences of others and especially to promote the small-scale dairy farming.

For the Farmers' Organizations

1) The farmers' organizations raise awareness of market opportunities where their member smallholder farmers can have opportunities to generate income through sustainable dairying.

2) The farmers' organizations at all tiers should be managed by democratically elected representatives of milk producers in accordance with the laws and regulations governing the constitution of the concerned farmers' organization.
3) The Boards of Directors/management of the farmers' organization should set and identify policies and targets. Actual execution of those policies and achievement of targets be delegated to the competent professionals employed in the farmers' organization and the professionals should be held responsible and answerable to the Board.

For the Asian Productivity Organization

1) The seminar participants and resource persons applauded the Asian Productivity Organization, Tokyo and the National Productivity Organization, Pakistan in having initiated the process of sustainable development of dairy sector through the involvement of the resource poor milk producers with the noble objective of poverty alleviation. It is expected of the APO to continue to further this objective through following actions.
2) The APO should set up a 'Dairy Project Division' in collaboration with international funding agencies such as Asian Development Bank. The Dairy Project Division should undertake dairy sector reviews in APO member countries. Based on the sector reviews it may prepare in collaboration with competent national organizations 'Project Identification Reports' and 'Project Proposals' for submission to Asian Development Bank, World Bank and other multilateral funding and donor agencies to individually or jointly finance the dairy projects. The APO may involve the external experts and international organizations such as Food and Agriculture Organization of the United Nations in preparation of project reports, project proposals and in facilitating the discussion with funding agencies.
3) The APO may organize seminars and meetings on regular basis in other countries to help develop smallholder dairying.

1. SUSTAINABLE DEVELOPMENT OF THE COTTAGE DAIRY SECTOR IN ASIA AND THE PACIFIC – CHALLENGES AND OPPORTUNITIES

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INTRODUCTION

Defining sustainable development in a dynamic, fast growing and modernizing society is truly difficult. Philosophically, sustainable development must maintain a balance between resource availability, resource integrity and resource utilization. An ideal definition (Brundtland, 1987) is that, "Sustainable agricultural development is a development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs". Quite a difficult task, it is. Let us expect that the present generation is conservative and careful in utilizing the resources. What about the future generation? The demographic changes happening the world over are clearly indicative that the needs of the future generation are going to increase many times more. The increasing population would create increasing pressures on the resources. The solutions to these conflicts obviously lie on the present generation. It is our responsibility for tomorrow to: preserve land and natural resources, ensure continuing food security, protect environment, generate employment particularly for the poor and create a healthy society, and to sustain these to continue to develop improved technologies that can help optimization of use of the existing resources for future needs. **Sustainable Dairy Development** can be possible by keeping such breeds of cattle and buffaloes that would require minimal and inexpensive external inputs; are efficient converters of by-products of agricultural crops and of the processed foods; can survive the harsh weather and sustain in rural environments, and are resistant to local and exotic diseases. Such dairy animals would invariably be those yielding low volumes of milk. The high yielding milk animals invariably have high rate of metabolism and require far better quality of feed and fodder. Such quality feed and fodder must be cultivated and would then compete for land needed for growing crops for human consumption. Also the cost of milk production on grown crops and fodder would be higher than the cost of milk produced by feeding agricultural by-products.

In many developing countries in Asia milk production is a subsidiary occupation. It is a typical cottage industry where, cattle and buffaloes have multipurpose use. They produce milk, meat and are used as draught power for cultivation. They are sustained on agricultural by-products, local grazing and managed by the household labor. Obviously the cost of milk production is low.

STATUS OF MILK CONSUMPTION AND POVERTY IN ASIA

Milk Consumption: No doubt that the per capita production and consumption of milk is rising fast in Asia. But the consumption levels of milk, protein, and calorie intake are below the global levels of consumption (Table 1). In Asia there are significant inter-country variations in milk production and consumption. Most of the Asian countries are heavily populated and a small increase in population increases the pressure on production and the resource-poor nations (Table 2). Most of the Asian countries are heavily dependent upon imported milk and milk products. Countries like Pakistan have good consumption of milk, which is far above the nutritional requirement. Despite that Pakistan imports large quantities of milk and milk products.

Poverty: Of the 815 million undernourished and food-insecure people in the world, 61 percent live in Asia (FAO, 2002). The incidence of poverty in Asia varies from 2 percent in Malaysia to 33 percent in Bangladesh (Table 2). The problem is acute in the rural areas where majority of the poor live. Poverty is a major cause of food insecurity. Cottage dairy development has the potential to alleviate poverty. It can provide employment to the family, provide income on a daily basis, and provide milk for

home consumption. Milk being complete food is a good source of nutrition for the rural poor. Already livestock production is growing faster than the crop output. It is predicted that by 2020 the livestock production would produce more than half of the global agricultural output in value terms.

Table 1. Per Capita Milk Production, Consumption and Intake of Calories and Protein in Selected Asian Countries in Year 2000

Country	Per Capita Milk Production (kg per annum)	Per Capita Milk Consumption (kg per annum)	Per Capita Calories Intake (kcl per day)	Per Capita Protein Intake (gm per day)
Bangladesh	15.7	16.0	27	1
Myanamar	13.1	19.6	30	2
Sri Lanka	15.7	41.9	72	4
India	82.4	81.2	158	7
Indonesia	3.8	7.7	12	1
Laos	1.2	4.1	8	0
Malaysia	2.3	54.0	116	4
Nepal	52.0	50.0	102	4
Pakistan	191.1	156.8	341	16
Philippines	0.1	23.1	30	2
Thailand	7.6	21.3	35	2
Vietnam	1.1	4.7	7	0
China	9.7	11.1	21	1
South Asia	85.4	82.2	162	7
E&SE Asia	8.2	16.3	26	1
Asia	44.0	48.7	90	4
World	96.7	94.4	145	7

Ref: Quoted from Taneja and Birthal (2004) calculated by them based on FAO Statistics

Table 2. Population Growth, Urbanization, Undernourishment, and Rural Poverty in Selected Asian Countries

Country	Annual Population Growth (%) 1990s	Urban Population Growth (%) 1999	Rural Poverty (%)	GNP/Capita (US$ per annum) 1999	Undernourished Population (%) 1999
Bangladesh	2.04	24	39.8 (1996)	370	33
Myanmar	1.52	27	NA	NA	7
Sri Lanka	0.97	23	24.4 (1991)	820	23
India	1.63	28	34.2 (1997)	440	33
Indonesia	1.38	40	22.0 (1998)	600	6
Laos	2.24	23	46.1 (1993)	290	28
Malaysia	2.02	57	19.3 (1989)	3,390	2
Nepal	2.18	12	44.0 (1996)	220	23
Pakistan	2.28	37	36.9 (1991)	470	18
Philippines	1.97	58	51.2 (1997)	1,050	24
Thailand	1.26	21	15.5 (1992)	2,010	21
Vietnam	1.56	20	57.2 (1993)	370	19
China	0.91	32	4.6 (1998)	780	9
South Asia	1.73	28	40.0 (1998)	-	24
E&SE Asia	1.48	41	15.3 (1998)	-	10
Asia	1.58	36		-	16
World	1.30	47		-	

Ref: Quoted from Taneja and Birthal (2004) calculated by them based on FAO (2001) Statistics and World Bank (2001)

COTTAGE DAIRY INDUSTRY

Cottage Dairy Industry (CDI) is an occupation of farmers who are generally landless or have very small cultivable land. They cannot afford to use land for growing of crops or fodder that would be used as input for commercial milk production. The farmers keep 3-4 animals for producing milk, meat as well as power source for agricultural purposes.

Opportunities

CDI supplements agriculture: Take for example, the case of India. Employment of the rural poor in dairy is increasing. Dairying is more dependable and perennial source of income than crop production. According to census 2000 the workforce associated with crop production has fallen from 74 percent in 1961 to 54 percent in 2000. The population engaged in management of animals and milk production increased from 2 percent in 1961 to 4.1 percent in 2000 (Alagh, 2002). This shift indicates that small and marginal dairy farmers fortify the development and growth of the rural farm and nonfarm sector and rural employment.

CDI supports the landless and small landholder: Distribution of livestock holding in India appears more equitable than land holding as bottom 60 percent of rural households own 65 percent of all milking animals. Contribution of livestock, during the last few decades, to the national Gross Domestic Product (GDP) has increased from 4.8 percent in 1980-81 to about 5.6 percent in 1999-2000.

CDI employs family labor*:* Cottage dairy has an immense potential to alleviate poverty. The animals are managed by members of the family particularly those who are unemployed. The housewife, and young boys and girls before and after their school time can look after the animals.

CDI and women's role: Rangnekar's study on the characteristics of production activities preferred by women (see Box 1) is very informative. All the activities of cottage dairy clearly fit. Also the dairy activities do not put any extra pressure on women and can be timed as part of the household chores. Observations made in the dairy cooperatives in India have indicated that the money earned by women from sale milk are used in managing the household. Since income from milk is earned twice a day it helps good upkeep of milking animals as well that of the family.

Box 1

Characteristics of Production Activity Preferred by Women

(Reproduced from Rangnekar, 1999)

1. Should be easily manageable within available time, resources and skills
2. Should contribute to family nutrition and family events/celebrations
3. Should need low external input
4. The produce should be easily marketable and provide, may be small, regular income
5. It should enable creation of easily encashable asset for any exigency

CDI supplements nutrition: First priority for the milk produced is for consumption by the family and the surplus after meeting the family's requirement, is sold.

CDI utilizes crop residues: The population pressure in Asia puts the livestock to a decisive disadvantage as far as the use of land is concerned. It is impossible to think that livestock can be raised on cultivated feed and fodder. Despite the fact that India has the largest population of cattle and buffaloes in Asia, she has never utilized more than 3 percent of its land resource for fodder cultivation and grazing. According to actual nutritional requirements the Indian cattle and buffaloes deserve to be given 8 percent of cultivable land for fodder and grazing.

Challenges

CDI: Organizational logistics: The base of CDI is that milk production is by farmers with small landholding in the rural areas. Milk production per animal is low. There are many milk producers clustered within a village. The villages are scattered and away from the urban consumption centers. The major challenge is to organize this scatter and to weave a network that can make the system work as an industry.

CDI: Sustained and regular payment: Another challenge of the CDI is that the each of the small milk producer is dependent upon income from sale of milk produced daily. This weakness has to be countered by ensuring regular payment to the producer.

CDI: Assured veterinary health care and insurance: Milking animal an asset of the producer. The cattle wealth would be under continuous threat of local and infectious diseases because of the rural conditions of poor sanitation, bad hygiene and ignorance for countering these problems. Occurrence of infectious diseases can be a cause of mortality and morbidity amongst animals. A poor farmer can ill afford such calamities. There is a need that he is supported by immediate first aid facilities and veterinary healthcare facilities are available on call and at affordable cost. The infectious and epidemic diseases as well as the vagaries of weather seriously affect the poor. These can take a toll on the life of cattle and buffaloes. Milking cattle being mainstay, their loss can be a big set back to the farmer and his family. It is important that farmers' animals are insured against such casualties.

CDI: Improved rural infrastructure and communications: Poor rural infrastructure particularly road network and telecommunications has hindered the growth of the rural poor. Availability of good infrastructure has significantly assisted in poverty reduction. Access to road transport has reduced travel time, provided better access to basic education and health services, enabled the poor to find better paying work, allowed production of higher value cash crops and helped realize better price for their produce (World Bank Project: Poverty Reduction Support Credit in Pakistan). When up scaling rural infrastructure projects several elements must be taken into account, such as a strong pro-poor policy environment, as well as a plan for sustainability of infrastructure services. Study of the cybernetics in dairy industry (Khanna, 2003) found that wireless communication tracked milk carriers for breakdown, networked the veterinarians to quickly reach animals suffering emergency in far flung rural areas. Success prompted replication by many of the dairy cooperatives and public sector organizations in India. The communication helped the cooperatives make inroads as welfare organizations. While medical services were denied to humans their buffaloes got better veterinary care. The veterinarians in fact worked as the medicos to both the animals and the sick rural folk. If they became divine saviors, their divinity was a thanks to the telecom revolution.

CDI: Assured marketing backup: In the rural areas where milk is produced, there are many milk producers and a few buyers. This is inherent because volume of milk produced per farmer is very small. Where there is no adjacent urban center for ready off take of milk the prices of milk depress. Many weak sellers and only a few discretionary buyers characterize the market structure. An individual trader can choose not to buy milk on any given day. A trader tends to behave irrationally and is interested in increasing his profit. This situation is an ideal recipe for market failure. The challenge is to provide assured purchase of milk from the small milk producers.

GLOBALIZATION AND TRADE LIBERALIZATION

Challenges

Globalization Objective: The underlying objective of globalization and trade liberalization has been to create a single world market. The advantage would be that those who produce a product the cheapest should market it globally. Neutrally, this would an ideal situation. But in practice this does not work. Those with financial and muscle tend to dominate the poor and weak.

Distortions in World Trade: The international dairy sector is no exception. World trade in dairy products has been distorted for decades by both domestic and border policies. In spite of regional and multilateral trade agreements, dairy policies continue to distort resource use and world market prices. In many developed countries, dairy markets are highly protected. For example, the in the United States, the dairy markets are protected by Section 22 of the Agricultural Adjustment Act of 1933, as amended. This provision prevents dairy imports from interfering with the dairy price support program of the United States Department of Agriculture. Most developed countries provide subsidies to their producers. The levels of producer subsidy have been high throughout the 1980s and 1990s and are continuing through the new millennium. Most of the developed countries also provide heavy export subsidies under their export subsidy programs to increase their exports. This has created unhealthy competition in the domestic markets of the importing countries. The developed countries mount intense lobbying pressure at the WTO meets to retain the protection and to provide subsidies to producers.

Import Tariffs: Developing country like India had committed zero percent base and bound rates on imports of skimmed and full cream milk powders and 40 percent on butterfat, cheese and whey under the WTO agreement. In contrast, the bound rate of duty for fresh milk and cream, buttermilk and

yogurt was fixed at around 100-150 percent. No country other than Singapore has agreed to zero rate of duty. As of 1999/2000, the average tariff on agricultural products was about 14 percent for the US, 30 percent for the EU and 33 percent for Japan, compared to less than 5 percent for non-agricultural commodities. Among the US, the EU and Japan, some of the highest tariffs are for dairy products. The tariff rate for butter/butter oil was: Japan – 450 percent; the US – 134 to 144 percent; the EU – 144 to 147 percent; Canada – 298 percent; Poland – 102 percent; some of the developing countries: India – 40 percent; Pakistan – 100 percent; Bangladesh – 200 percent; Indonesia – 210 percent; South Africa – 79 percent. (Sharma, 2000) Similarly, for milk powders, the import duties in developed countries were much higher compared to India.

Subsidies: Poor and developing countries cannot afford to provide any such doles to farmers despite the fact that their farmers do not realize even the cost of milk production. The net result is that such distortions not only make the poor remain poor but the poor become poorer also. This is despite the fact cost of milk production in these countries is far cheaper than the milk produced by the already rich and highly subsidized dairy farmer in the developed countries.

Non-Tariff Barriers: Apart from the tariff and subsidies, the developed countries also raise non-tariff barriers to imports from developed countries. These could be through sanitary and phyto-sanitary measures and special safeguards provision to which most developed countries have no alternative solution.

Opportunities

Asian Dairy Products Market: The world population is expected to increase to 8.26 billion by 2025 with an annual average growth rate of about 1.3-1.5 percent. Of this about 62 percent would be in Asia. The disposable income of people in Asian countries is expected to increase at 3 percent to 5 percent annually as compared to an average rate of 1 percent annual in the developed countries. These combined are expected to grow the demand for milk and milk products by 5 percent in Asia as compared to 1.66 percent in the world. More than half of Asia's population would comprise age group below 25 years. Increasing urbanization is expected to expand the potential market for the dairy sector. Rising awareness about hygiene standards and adulteration of milk has led consumers in urban areas to switch to processed packaged milk and milk products. Thus, the total demand for milk and milk products in Asia would increase from 155 million tons in 1998 to 567 million tons in 2025.There is great opportunity for milk producers of Asia to capture this in house demand before it is taken over by other.

Ready-to-eat Food Market is growing at double the rate of consumer market. There is an increasing consumption of food products 'away-from-home'. The concept of food parlors is opening new vistas for ready-to-serve dairy products, which would ride piggyback on the fast food revolution sweeping across urban Asia. There is growing market for dairy products as ingredients used as raw material in pharmaceutical and allied industries.

Increasing Milk Production in Asia: The most critical issue now confronting the world dairy industry is the fact that world milk production is not expected to be able to keep up with the increasing demand for dairy products. Milk production will grow in Australia, New Zealand, the US, Mexico, Argentina, India and China, but not in the EU, due to supply control system.

Low Cost Milk Production in Asia: At less than 20 cents a liter, the farm-gate price of milk in Asia and the Pacific is one of the lowest in the World. The Asian dairy farmer does not receive any subsidy. Hence, the Asian milk products in the post-WTO world can out complete those from many advanced nations that now dominate global markets.

World Trade Organization (WTO) is both a threat and an opportunity. The developed countries have been more vigilant of the implications of the WTO on their market than the developing countries. The developing countries can provide tough competition in the agricultural sector because their cost of production is generally lower than the cost of production of agricultural commodities in developed countries. Thus at the WTO, the issues that surfaced for discussions were very significant: need for substantial reduction in peak tariffs; facilitate greater market access to developing countries; an appropriate mechanism to check tariff escalation and under various tariff preference schemes, developing countries should be harmonized with the tariff reduction negotiations. Owing to anomalies in the implementation of tariff rate quotas, the market access provision of the Agreement on Agriculture is greatly undermined, particularly in case of developing countries.

Co-operation Amongst Asian Countries: There is need of a strong co-operation amongst the countries in the Asian Region and a continuing dialogue. These countries should stand together at the WTO and build pressures to invoke provisions of the WTO that create a level playing field and give equal opportunities for international trade and marketing.

Domestic Trade Liberalization: The Australian dairy industry of the 1980's was "Very regulated and inward looking" (Chris Phillip, 1999). It received price support from the government, all the companies operated as a pool and common wholesale prices, avoiding competition and involved a large number of small producers. The business was limited to domestic sector with no international marketing strategy. Since exports to the EU countries were through accession negotiation, and since Australia was perceived as a subsidized dairy industry the export contracts shifted to New Zealand. The change started after 1980, when the Australian Federal government linked domestic dairy prices to the international prices and reduced domestic price subsidy from around 40 percent to 20 percent. As a result in the next 10-15 years, the Australian milk production declined by 30 percent; dairy herd size reduced by 35 percent; number of dairy farms declined by 50 percent; and the export volume declined by 40 percent. The structural changes announced by the government shook the industry to become independent, market savvy, and internationally competitive. Results were dramatic. From 1990s Australian milk production rose from 6.5 billion liters to 10 billion liters; of the total production more than 50 percent products were exported; and the industry became vibrant and internationally competitive.

Until 1990s the Indian dairy industry was also very closed and inward looking. Domestic changes occurring in the Indian dairy sector have been similar to that of the Australian dairy industry. As a consequence of the liberalization, there was less governmental intervention and regulations. The negative implication was that fall in international prices of dairy commodities particularly bulk milk powder, butter and butter oil increased their import and the small industrial units suffered the most. Nevertheless, the industry has learnt to compete. With reduction in the subsidies by the developed countries viz., the United States, the European Union, Canada &c. the situation has changed during the new millennium. India is a new entrant to the international dairy market. The exports from India are miniscule compared to the international dairy trade in dairy products. Nevertheless, the domestic policies have made India to compete successfully in the international market.

RECENT DEVELOPMENTS

There are many areas in which research and development efforts made have brought about and can bring about many positive implications to the development of the CDI. Effort has been made to shortlist the recent developments that have helped in reducing the cost of milk production at the farm gate, added value to the farmer's produce and his price realization; and the organizational innovations that can help network the scattered milk producer. For the CDI to succeed it is important that the cost of milk production is low at the farm gate. This is achievable by increasing the per animal milk production, increasing the lifetime production per animal. Discussed below are the inputs that can help enhancement of milk Production through improved feeding, breeding practices, improved veterinary healthcare and by producing designer milk.

Enhancement of Milk Production through Improved Feeding Practices

Efficient use of land for forage production and new technologies for improving use of agro by-products (Srinivas Rao et al., 1999) can be made possible by many means. Instead of growing fodders as main crops grow short fodder crops crop inter-regnum. In addition it should be possible to increase productivity of crops that provide good quality by-products. Some such crops are sugarcane, sun hemp, cowpea, carrot, cauliflower, and turnip. To improve soil productivity and crop productivity there is a possibility of growing fodder crops that can enrich soil fertility in fruit orchards. The information given here is not exhaustive but indicative of the possibilities that exist for exploiting synergies. For example:

- In Guava, citrus and mango orchards grow: Anjan, Rhodes, Stylo and Siratro grasses;
- In coconut and banana orchards grow: Pillipsera, cowpea and sun hemp fodders;
- In Vegetable orchards grow 3-4 rows of hybrid Napier and lucaena plants; and
- In beetle nut and vine orchards grow: Sesbania.

Technologies for improving agro by-products: Many of the agro by-products particularly straws have low total digestible nutrients. Technologies are available to improve these. For example: Urea molasses treatment can improve the quality of dry fodders and straws of wheat and rice. Urea molasses mineral lick can be used as a supplement to straws. This can help improve the digestion of cellulosic fodders and the rumen micro-flora. Making silage from greens like lucerne and berseem when these are available in plenty is very helpful. First, it improves the nutritional value of these fodders; and second green fodders are stored for use during the scarcity period. By pass protein feed can be used to enhance the availability of total digestible nutrients and digestible protein. It is known that degradation of nutrients in the rumen beyond meeting the minimum requirement of micro-flora is uneconomical. By using the proteins that bypass the rumen the nutrient available to the animal can be increased. Therefore using by pass protein feeds is more economical. There are many additives, hormones and micronutrients that can improve the bioavailability of nutrients in the feeds and fodders given to animals. Some of these are: bovine somatotropin for increasing the conversion efficiency of nutrients; organic trace elements combinations like zinc-methionine, copper-lysine, selenium-chromium-yeast to increase the bioavailability of nutrients, enhance immune status of animals and increase the reproductive performance of the animals. Addition of bacterial inoculants e.g. lactobacillus and pediosoccus species in making silage increases the digestibility and milk production of animals. Use of multifunctional additives based on essential oils can increase the nutrient digestibility and feed conversion ratio (Gunther and Ulfah, 2003).

Enhancement of Milk Production through Genetic Intervention

Progeny Testing and Frozen Semen: Milk production is a polygenic trait. For increasing the milk production principles of population and mathematical genetics were applied to develop sire indices amongst herds. Based on these indices good quality bulls were identified and their semen was used for improving the population for milk production and allied traits. Frozen semen of a tested bull can be sent over a wide geographical area and used for breeding of a large number of females. While identification of bulls on this process is still continuing, the use of good yielding females has helped increasing the genetic gains faster than using progeny tested bulls alone. Techniques are now available to produce more than one offspring from the same female. With the help of hormones the female is made to produce multiple ova. These ova can be frozen for future use of immediately transferred to synchronized females. Generally the females giving low volume are used for implantation of fertilized embryos of high milk yielding females. This type of Open Nucleus Breeding System with multiple ovulation and embryo transfer when combined with semen from progeny tested bulls can give faster genetic gains. Through DNA mapping gene complexes of milk production are possible to be identified (Goswami, 2003). This information can be used in transgenesis and identification of females with higher milk production ability. This technique has not been used very widely. Techniques are under development for cloning of animals.

Enhancement of Milk Production through Improved Health Services

Healthcare and management of animals is important particularly when animals are maintained in holding size of 2-3 animals per family. Owners of the cottage dairy in the rural areas are poor, uneducated, their animals are maintained under deprived nutritional conditions, generally kept in unsanitary and bad hygiene and do not have access to any health management on modern lines. This does not allow full expression of the genetic potential of the milking animals. It is therefore possible to enhance milk production per animal by providing optimal veterinary health care to the animals. Proper healthcare management of the animals in the cottage dairy is possible through a three-tier treatment system.

First Aid: At the village level facilities should be made available for first aid. The cheapest way to provide this facility is to train a local resident of the village as veterinary assistant (bare-foot doctor). He should be able to diagnose and providing immediate relief to the sick animals. Any sickness for which he is unable to provide help he should contact the source for regular veterinary services.

Mobile Veterinary Service: The second tier is the mobile veterinary service that should visit the villages on predetermined days and scheduled time. The cattle owners should know the place of assembly and the local bare-foot doctor should help them. The veterinarian should be able to treat all diseases particularly mastitis, helminthes infestations, micro-mineral deficiencies, parasitic infesta-

tions, tuberculosis, paratuberculosis, poxes, etc. The veterinarian should provide medicines and follow up instructions to the local assistant for further treatment of sick animals.

Vaccination against Epidemics: Major problem that the animals face is the epidemics. The state governments are able to track occurrence such diseases through the epidemiological surveillance system. These diseases are main source of large-scale mortality and morbidity amongst cattle and buffaloes. It is important to provide regular vaccination to animals against known infectious and contagious diseases e.g., foot and mouth, rinderpest, Haemorrhagic septicaemia, brucellosis, anthrax, black quarter, haemoprotozoan diseases, infectious bovine rhinotracheitis, acute undifferentiated diarrhea of newborns.

Biotech Intervention to Produce Designer Milk

Biotechnological intervention through gene transfer in animals has been used for production of designer milk by encoding tissue-specific genes, chromosomal location of genes, organization of clustered genes and occurrence of pseudogenes. It is now possible to design the make up of milk protein suitable for specific application in the dairy industry, and for healthcare. It would be possible to produce milk with increased protein content. The biotechnological tailoring of milk protein is likely to help in producing milk with various pharmaceutical properties and immunogenic properties. Milk with modified lactoglobulin to reduce allergic response to milk can help in feeding milk to persons who are lactose intolerant. Possibilities exist to modify concentration of lactoferrin for superior bioprotective properties to provide greater passive immunity to the host against enteropathogenic infection. Transgenesis in mammary gland of proteins having desirable functional attributes is an attractive proposition as milk is relatively free from viruses.

Value Addition to Farmer's Price Realization

Branded Milk Products: Branded western and ethnic dairy products are witnessing rising demand and increased acceptance, especially among urban consumers. Ethnic products, e.g., sweets, cottage cheese, yogurt, curd, kefir, etc., offer growing opportunity for the organized sector. The success of the branded curd, flavored milk, and traditional sweets such as shrikhand, gulabjamun, peda and burfi launched in India suggest the potential for introducing such products to the masses. There are significant improvements in quality of processing and product manufacture**.**

Quality of Milk Products – the TQM Approach: Improvement in the quality of milk products has to follow the entire chain from milk production at the doorstep of the producer until the product arrives the consumer.

Good Hygiene Practices: For best quality end product it is necessary that good hygiene practices be adopted at the primary production stage. In particular care should be taken to identify the specific points in the activities of primary production. The producer should implement measures to control contamination from air, soil, water, feedstuffs, fertilizers, pesticides, pharmaceuticals, drugs, etc.

Good House Keeping: Good house keeping should be a responsibility of the sectional heads, particularly the persons working close to the place of work, while the Administration head is given responsibility for the total housekeeping. The principles of house keeping - the '5 S' viz.: Seiri (Sorting Out); Seiton (Arrangement); Seiso (Cleaning); Seiketsu (Personal Hygiene); and Shitsuke (Self Discipline).

Good Manufacturing Practices: This is a most important step in ensuring safety and suitability of food production in the entire chain from primary production through manufacturing, processing, servicing, distribution, marketing and retailing to the consumers. The internationally recognized Codex Principles of Food Hygiene are:

- Identify essential principles of food hygiene applicable throughout the food chain to achieve the goal of ensuring that food is safe and suitable for human consumption
- Recommend a HACCP based approach as a means to enhance food safety
- Indicate a system/procedure to implement those principles
- Provide guidance for specific codes, which may be needed for activities of food processing to amplify the areas of hygiene requirements

Identify with ISO: It is important to identify the organization with the standards of the International Standards Organization and the category in which the organization fits in. The generic standards of the ISO are: ISO 9001 – a standard that provides a model for quality assurance in design and development, production installation and servicing; ISO 9002 – a standard that provides a model for quality

assurance in production and installation; and the ISO 9003 – a standard that provides a model for quality assurance in final inspection and test.

HACCP: HACCP is a food safety management standard brought out by the Codex Alimentarius Commission. HACCP is based on the following principles:

- Conduct a hazard analysis. Four major components of hazard analysis include the hazard identification, the hazard characterization, the exposure assessment and the risk characterization;
- Determine the critical control points (CCPs);
- Establish critical limit(s);
- Establish a system to monitor control of the CCPs;
- Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control;
- Establish procedures for verification to confirm that the HACCP system is working effectively; and
- Establish documentation concerning all procedures and records appropriate to these principles and their applications.

Application of Information Technology at Rural Level

Computerized Automatic Milk Collection: Application of information technology and computers has helped the Gujarat cooperatives in India to change its rural face. Some 3000 cooperatives have stand alone computerized automatic milk collection units (Bhatnagar, 2003). They capture information of fat content of milk, its volume and calculate the amount and the payment is made on the spot. The process has increased the trust, transparency and efficiency of milk collection. Internet would be introduced to link all e-transactions between the village cooperatives and the processing dairy.

Geographical Information System (GIS) software is being used at the village level for census data on farmer-members, their landholding and animals. This statistics helps in planning on milk production, improving productivity of animals, in tracking the animal health and epidemiological trends.

RECENT DEVELOPMENTS IN ORGANIZATIONAL INNOVATION

China's Collective Farm Model

In an effort to address employment challenges in rural parts of China, the New Hope Dairy Group (NHDG), one of China's leading industrial conglomerates, established supply-chain links in the dairy industry to raise the incomes of poor farmers in Sichuan province. NHDG is one of the largest private dairy companies in China. It acquired comparative advantage in an industry where low capacity utilization, farm mismanagement, and poor animal husbandry have meant low quality and productivity. The key lay in employing collectivized, mechanized milking facilities among other sources of raw milk supply. Astonishingly, the collective farm model in Sichuan province not only enhanced productivity and milk quality but also generated higher income. Because the concept was new, getting farmers to participate required community and governmental support, a challenge successfully met by NHDG. Also critical was NHDGs ability to work with an array of stakeholders and to adapt approaches to local situations. So far, the scaling up of the collective farm model has been successful in the eastern and northern China.

India's Milk Revolution

Over the last 30 years, the Indian dairy industry has progressed rapidly, making India the largest producer of milk in the world. India's dairy farmers today employ modern technology and advanced management systems in milk processing to offer consumers more quality choices (Figure1). Funded by external sponsors, including the World Bank, Operation Flood played a key role in this transformation by reaching small rural producers through dairy cooperatives. The principle of the program – to connect people with their government, institutions, and markets – made it appealing to producers because it helped overcome barriers of caste, class, and power. Empowering producers by involving them in the daily working of the cooperatives also contributed to Operation Flood's success. Among the lessons of the program were that economic empowerment lays the foundation for political and social empowerment.

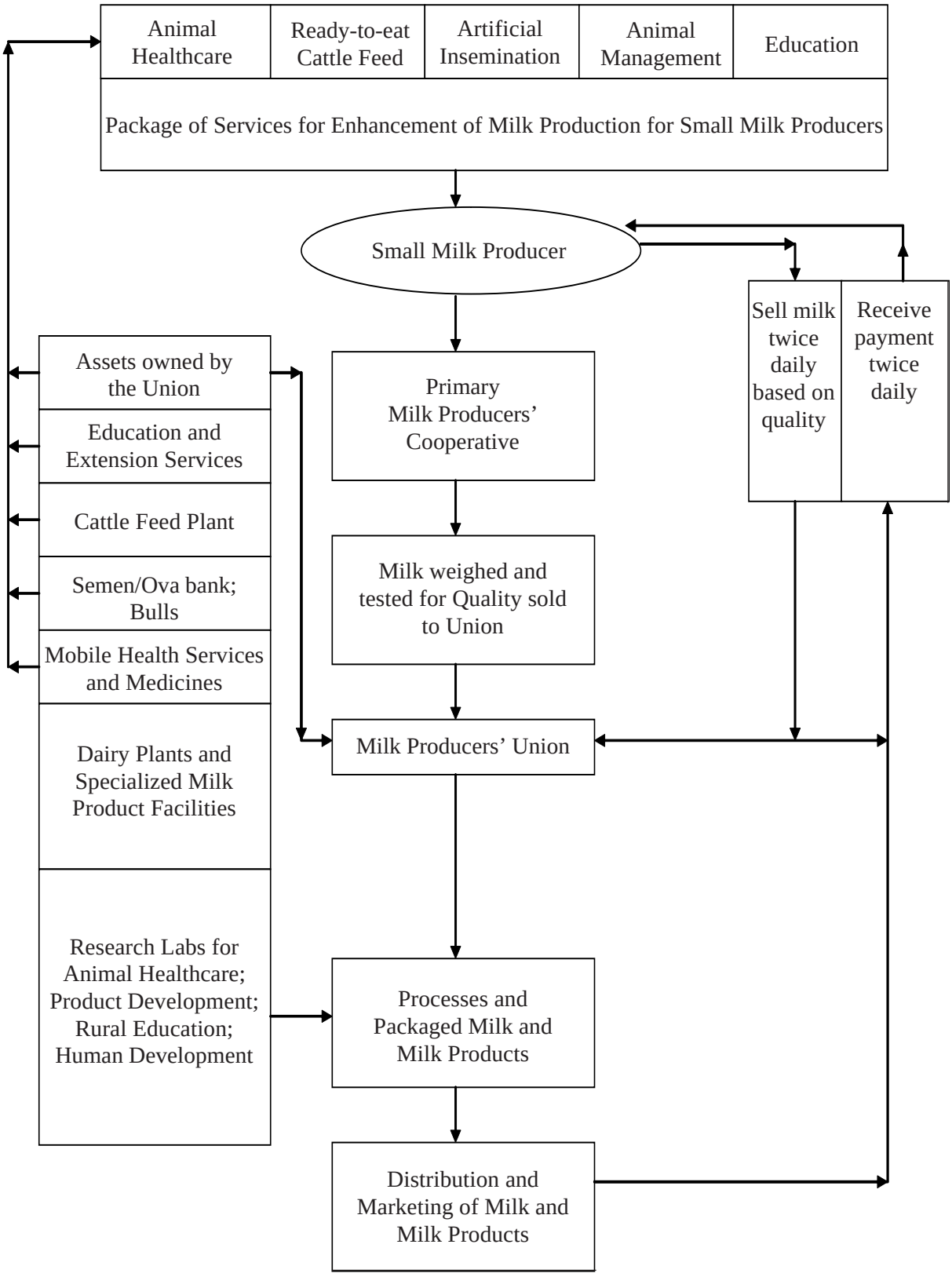

Figure 1. Organizational Model for Cottage Dairy Industry

Anand pattern of cooperatives tested for 25 years formed the basis for Operation Flood. The core feature of this model is the farmer control at milk procurement, processing and marketing. Strength in marketing helped realize better price for milk than was otherwise realized by individual milk producer. The success of marketing is a function of the 'brand' – AMUL. The key to their success is that the

cooperatives are a combination of the wisdom of the milk producers and the professional competence of the managers. They together can attain levels of achievement far surpassing that of many an established enterprise in the corporate sector.

INTEGRATION AND APPLICATION OF RECENT DEVELOPMENTS WITH THE COTTAGE DAIRY INDUSTRY

The research and developments in the recent past have been so many that these have the capability of changing the face of dairy industry beyond known proportions. But application of each one of these developments would required varying levels of financial investments in creating the basic facilities as well as logistics infrastructure to convey the facilities to the small farmers in the rural areas. Considering the state of cottage dairy industry the recent developments discussed above would be irrelevant and redundant unless these are delivered to the benefit of the poor.

According to the World Development Report (2004) broad improvements in human welfare will not occur unless poor people receive wider access to affordable, better quality services in health, education, water, sanitation, and electricity. Without such improvements in services, freedom from illness and freedom from illiteracy – two of the most important ways poor people can escape poverty – will remain elusive to many.

To reach such services to the poor and to reduce poverty it is important to build institutions that would market these and other services. Without effective institutions, poor people and poor countries are excluded from the benefits of markets," says World Bank Chief Economist and Senior Vice President Nicholas Stern. (World Development Report 2002) According to his report infrastructure standards and regulations typically exclude small entrepreneurs who lack the capital or technology required. The Report 2002 has identified four principles for building effective institutions. These are complement what exists; innovate, connect; and promote competition.

The design of any single institution should take into account the nature of the supporting institutions, skills, and technology. Institutions are not immutable and should continue to innovate. They should experiment with new institutional arrangements and continue to modify or abandon those that fail. The institutions must connect communities through open information flows and open trade; and foster competition between jurisdiction, firms and individuals. Competition creates demand for new institutions, changes behavior, brings flexibility in markets and leads to new solutions.

It is important such an infrastructure facilities on ground to reach the poor. These infrastructure facilities should convey technology, techniques, knowledge and information to the smallest and the poorest. Otherwise the efforts made and results achieved by research and development would remain consigned to the laboratories. Basic to bringing the cottage dairy industry out into a vibrant and commercial structure and use it to benefit the poor, raise their status, reduce poverty, is to create that structure. The organization should integrate the small milk producer to the systems of milk production, procurement, product processing, marketing and research and developments with the CDI (see Figure 1). India's cooperatives and China's farm collectives are good examples of such an integrative organization.

CONCLUSIONS

The research and developments in the recent past have been so many that these have the capability of changing the face of dairy industry beyond known proportions. But application of each one of these developments would required varying levels of financial investments in creating the basic facilities as well as logistics infrastructure to convey the facilities to the small farmers in the rural areas. If the recent developments cannot be applied to the cottage dairy industry the recent developments would be irrelevant and redundant. It is important to create infrastructure facilities on ground to reach these fruits of development to the poor of the CDI. The facilities should be adequate and capable to convey technology, techniques, knowledge and information to the smallest and the poorest. Otherwise the efforts made and results achieved by research and development would remain consigned to the laboratories. Integrated organization is basic to bringing the cottage dairy industry out as a vibrant and commercial structure that can benefit the poor, raise their status, and reduce poverty. The organization should integrate the small milk producer to the systems of milk production, procurement, product processing, marketing and research and developments with the CDI. India's dairy cooperatives and China's

farm collectives are good examples of such and integrative organization. Some of the challenges and opportunities of the CDI are summarized below.

Sustainable dairy development can be possible by keeping such breeds of cattle and buffaloes that would require minimal and inexpensive external inputs; are efficient converters of agric by-products and processed foods; can survive the harsh weather and sustain in rural environments, and are resistant to local and exotic diseases.

Despite per capita production and consumption of milk is rising fast in Asia, consumption of milk, protein, and calorie intake are below the global levels of consumption. Poverty is a major cause of food insecurity. Cottage dairy development has the potential to alleviate poverty. It can provide employment to the family, income on a daily basis, and milk for home consumption.

Cottage Dairy Industry (CDI) is an occupation of farmers who are generally landless or have very small cultivable land. They cannot afford to use land for growing fodder as input for commercial milk production. The farmers keep 3-4 animals to produce milk, meat as well as a power source for agricultural purposes. CDI supplements agriculture, is more dependable and perennial source of income than crop production.

Amongst the ***major challenges of CDI*** is that milk production is by farmers with small landholding in the rural areas; milk production is low and the producer depends on it for daily income. Local and infectious diseases threaten the cattle and buffaloes.

The underlying ***objective of globalization*** and trade liberalization has been to create a single world market. The advantage would be that those who produce a product the cheapest should market it globally. But in practice this does not work. The developed countries distort world market prices by subsidies and non-tariff barriers. Since cost of production is generally lower in developing countries the WTO should facilitate reduction of subsidies, facilitate greater market access to developing countries and check installation of non-tariff barriers.

Recent Developments: There are many developments that can bring down the cost of milk production by increasing the per animal milk production. Growing fodder crops in sequence of main crops; growing short duration fodder crops and increasing productivity of sugarcane, sun hemp, cowpea, carrot, cauliflower, turnip to increase availability of by-products. ***Improve the quality of dry fodders*** and straws of wheat and rice by treating with urea and feeding urea molasses mineral lick as supplement. By pass protein feed can be used to enhance the availability of total digestible nutrients and digestible protein. There are many additives, hormones and micronutrients that can improve the bioavailability of nutrients in the feeds and fodders given to animals. ***For increasing the milk production*** through breeding, bulls selected by sire index help. Their semen was used for improving the population for milk production and allied traits. Frozen semen of a tested bull can be sent over a wide geographical area and used for breeding of a large number of females. High milk yielding females can produce more than one offspring by Open Nucleus Breeding System with multiple ovulation and embryo transfer when combined with semen from progeny tested bulls can give faster genetic gains. ***Proper healthcare management*** of the animals in the cottage dairy is possible through a three-tier treatment system: village level first aid by trained local veterinary assistant (bare-foot doctor); a mobile veterinary service that should visit the villages on predetermined days and scheduled time. The veterinarian should be able to treat all diseases particularly mastitis, helminthes infestations, micro-mineral deficiencies, parasitic infestations, tuberculosis, paratuberculosis, poxes, etc., and vaccination against known infectious and contagious diseases, e.g., foot and mouth, rinderpest, Haemorrhagic septicaemia, brucellosis, anthrax, black quarter, haemoprotozoan diseases, infectious bovine rhinotracheitis, acute undifferentiated diarrhea of newborns.

Biotechnological intervention through gene transfer in animals has been used for production of designer milk with various pharmaceutical and immunogenic properties. Milk with modified lactoglobulin can help to reduce allergic response to milk. Persons with lactose intolerance can take such milk. Possibilities exist to modify concentration of lactoferrin for superior bio-protective properties to provide greater passive immunity to the host against enteropathogenic infection. Demand for milk and milk products are boosted by economic growth. As incomes rise, milk and milk products add to the diet. This directly increases food demand to a higher and more advanced level, creating a market for value-added dairy products. Increase in the population at an expected 1.3-1.5 percent per annum would increase demand for value added milk products.

Branded western and ethnic dairy products are witnessing rising demand and increased acceptance, especially among urban consumers. Ethnic products e.g., sweets, cottage cheese, yogurt, curd, kefir, etc., offer growing opportunity for the organized sector. The success of the branded curd, flavored milk, and traditional sweets such as shrikhand, gulabjamun, peda and burfi launched in India suggest the potential for introducing such products to the masses. To increase the price realization for the producer it is important to ensure that the end quality of milk products is excellent. The dairy plants should adopt the TQM approach for manufacture of good quality of milk products. The TQM approach ensures that the entire chain from milk production at the doorstep of the producer until the product arrives the consumer follows internationally known procedures for production of clean raw material to quality end product.

Application of information technology and computers has helped the Gujarat cooperatives in India to change its rural face. Some 3,000 cooperatives have stand alone computerized automatic milk collection units. They capture information of fat content of milk, its volume and calculate the amount and the payment is made on the spot. The process has increased the trust, transparency and efficiency of milk collection. Internet would be introduced to link all e-transactions between the village cooperatives and the processing dairy. Without ***effective institutions,*** poor people are excluded from the benefits of markets," says World Bank Chief Economist and Senior Vice President Nicholas Stern. (World Development Report 2002) The Report 2002 has identified four principles for building effective institutions. These are complement what exists; innovate, connect; and promote competition. The design of any single institution should take into account the nature of the supporting institutions, skills, and technology. Institutions are not immutable and should continue to innovate. They should experiment with new institutional arrangements and continue to modify or abandon those that fail. The institutions must connect communities through open information flows and open trade; and foster competition. ***The New Hope Dairy Group (NHDG)*** a large private dairy company in China has established supply-chain links in the dairy industry to raise the incomes of poor farmers in Sichuan province. To overcome low capacity utilization, farm mismanagement, and poor animal husbandry that caused low quality and productivity, NHDG employed collectivized, mechanized milking facilities for supply of raw milk. The system has not only enhanced productivity and milk quality but also generated higher income. So far, the scaling up of the collective farm model has been successful in the eastern and northern China. Over the last 30 years, the ***Indian dairy industry*** has progressed rapidly, making India the largest producer of milk in the world. India's dairy farmers today employ modern technology and advanced management systems in milk processing to offer consumers more quality choices. Funded by external sponsors, including the World Bank, Operation Flood played a key role in this transformation by reaching small rural producers through dairy cooperatives. The principle of the program – to connect people with their government, institutions, and markets – made it appealing to producers because it helped overcome barriers of caste, class, and power. Empowering producers by involving them in the daily working of the cooperatives also contributed to Operation Flood's success. Among the lessons of the program were that economic empowerment lays the foundation for political and social empowerment. ***Anand pattern of cooperatives*** tested for 25 years formed the basis for Operation Flood. The core feature of this model is the farmer control at milk procurement, processing and marketing. Strength in marketing helped realize better price for milk than was otherwise realized by individual milk producer. The success of marketing is a function of the 'brand' – AMUL. The key to their success is that the cooperatives are a combination of the wisdom of the milk producers and the professional competence of the managers. They together can attain levels of achievement far surpassing that of many an established enterprise in the corporate sector.

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2. ROLE OF SMALL AND MEDIUM ENTERPRISES (SMEs) IN SUSTAINABLE DAIRY DEVELOPMENT IN PAKISTAN

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INTRODUCTION

During 2003-04 milk production was 28.62 million tons and Pakistan was ranked fifth biggest milk-producing countries. Buffalo is the principal source producing about 66 percent of total milk; the balance 32 percent is from cows and 2 percent from goats and sheep. Pakistan is blessed with a good genetic of cattle and buffaloes, yet most of the animals produce considerably low quantity of milk due mainly to poor nutrition, management, disease control and lack of proper marketing. Dairy farming is an important sector of agriculture accounting for 49.1 percent of agricultural value added and about 11.4 percent of GDP. The role of livestock in rural economy may be realized from the fact that 30-35 million rural people are engaged in livestock raising, having average holding of 2-3 cattle/buffalo and 5-6 sheep/goat per family. This helps them to derive 30-40 percent of their income.

The livestock include cattle, buffalos, sheep, goats, camels, horses and mules. The livestock population comprises 25.5 million buffaloes, 24.7 million sheep, 54.7 million goats and 0.8 million camels (Table 1).

Table 1. Livestock and Livestock Products in Pakistan

		1999-00	2000-01	2001-02	2002-03	2003-04
Livestock (Million)	Cattle	22.0	22.4	22.8	23.3	23.8
	Buffalo	22.7	23.3	24.0	24.8	25.5
	Sheep	24.1	24.2	24.4	24.6	24.7
	Goats	47.0	49.2	50.9	52.8	54.7
Livestock Products (000 Tons)	Milk	25,566	262,840	27,031	27,811	28,624
	Beef	986	1,010	1,034	10,600	1,087
	Mutton	649	666	683	702	723

Dried milk and milk products valued at PKR 675.6 million have to be imported to meet the increasing demand, particularly in lean season of milk production. While bulk of the milk is produced in rural areas, it is consumed in urban areas. With increasing urbanization, the demand for milk will go up.

At present only 12 milk plants are in operation and about 20 plants have been shut down for various reasons. The processing capacity of these plants in around 0.65 million liters per day against which 0.43 million liters is used to produce UHT milk/pasteurized milk, butter, cheese, yogurt, ghee and ice cream. Some 97 percent of the total milk produced is traded as raw milk and 50 percent of which is used as fresh or boiled milk, one sixth as *dahi* and the rest is converted into varieties of indigenous milk products such as *khoya*, sweetmeats, ice cream, butter, *rubri*, *kheer*, cheese and other milk-based products.

CHALLENGES FOR THE DEVELOPMENT OF DAIRY SMEs IN PAKISTAN

Management: Managing of a successful dairy farm is a challenging job. A dairy farm should pay operating expenses and interest on capital. Both amount and type of resources depend on breeds of the cattle/buffaloes at the farm, soil type for fodder cultivation, available buildings and equipment, and

labor. A successful farm manager must have ability to plan well and possess a thorough knowledge of livestock production. There are shortage good skilled managers who can manage the farm profitably.

Breeding: Breeding good quality animals is main obstacle in making dairy farming as a SME in Pakistan. A good, efficient and healthy animal can't be raised if its reproductive efficiency is not improved. One main reason for low animal productivity in the past was intensive inbreeding. Breeding of animals has been continuing with bulls without any records and bulls used for draft purpose. Selected pedigree bulls of Sahiwal and Red Sindhi breeds are available in some areas for breeding purpose.

Feeding: For improving livestock productivity feeding and nutrition needs special and immediate attention by the researchers and the government officials. For instance, in traditional livestock farming they are fed through chopped fodder and wheat straw. In very rare cases, home grown grains, kitchen waste and concentrates are offered to milking animals. On the other hand commercial livestock owners, purchase fodder and concentrate from the markets and then sell milk at a rate that can pay for the expenses on feeding and labor.

Labor: An average livestock owner uses 3 to 4 of his family members as a source of labor in managing the farm. Hired labor is also used. Shortage of skilled labor is another problem for profitable dairy SMEs.

Disease Surveillance: There are heavy loss of animals and production due to outbreak of endemic diseases every year. The rural-based livestock farmers pay attention to life-threatening diseases and ignore less serious disease problems, which cause considerable economic loss through morbidity. However, commercial farmers are quite alert about disease problems and usually cull diseased or suspected animals and save the remaining herd. Hiring the services of veterinary doctors in commercial herds is common. Surveillance and reporting system also needs special attention. Disease diagnostic labs need to be strengthened and manned with qualified personnel.

Livestock Marketing: The marketing of livestock is an important point at which the producers turn over their stock to meat industry. The importance of marketing as a means to livestock development has not been duly recognized. The existing legislation provides for the establishment and supervision of primary markets for farm produce but does not include livestock. The livestock markets are therefore, poorly equipped, loosely controlled and operated in an old-fashioned way. Effective and efficient marketing of livestock and their products is important development program envisaged for the improvement of small and medium livestock industry.

Milk Marketing: The involvement of middlemen in selling and buying raw milk is quite common. Milk reaches the city markets through a long chain of middlemen. Between the producer and the consumer costs and commissions get added for passage of milk through big collectors, for haulage, for processing by chilling units and milk plants, for retailers till the milk arrives the real consumer. In this chain many operations take place, like mixing ice or water, skimming, churning, etc.

Price System: There are great seasonal fluctuations in prices of livestock products due to the fact that the livestock-based economy is uncertain as compared to other investments. Milk production increases in winter due to the calving pattern of buffaloes and cows, but at the same time the price of milk decreases in the open market without benefiting the consumer. Similar is the case in regard to meat. There is no grading system available for meat animals and carcass. Normally, butchers sell their meat according to their own prices, although, price fixation and stability in livestock production is a must for avoiding great seasonal fluctuations.

ROLE OF SMEDA IN THE DEVELOPMENT OF DAIRY SMEs

Contribution of Small Medium Enterprises is 30 percent to the total Gross Domestic Production (GDP) of Pakistan. SME sector is generating 25 percent of manufacturing sector's export earnings. Taking same as a safe estimate for other sectors, overall SME contribution in total exports equals US$3.07 billion. Its contribution to value added sectors of manufacturing industry has risen from 27 percent in 1980-81 to 35 percent in 1997-98. Countries like China, Taiwan, and Hong Kong have made progress due to the active participation of SMEs in their economy. Realizing this fact Government of Pakistan established Small and Medium Enterprise Development Authority in 1998. SMEDA is an autonomous body working under Ministry of Industries, Production and Special Initiatives. SMEDA

has aligned its services to the requirements of SMEs in various regions of the country. Currently in addition to liaison with Government, SMEDA provides number of services to both individual SME as well as SME clusters. SMEDA helps SMEs in providing feasibility studies, business plan development, technical assistance, training and e-business facilities. SMEDA provides facilitation of SMEs through:

- ***Creating a Conducive Environment*:** In collaboration with policy makers to devise facilitating mechanisms for SMEs by removing regulatory impediments across numerous policy areas
- ***Cluster/Sector Development:*** Formulation and implementation of projects for SME clusters/sectors in collaboration with industry/trade associations and chambers
- ***Enhancing Access to Business Development Services:*** Development and provision of services to meet the business management, strategic and operational requirements of SMEs

Pre-feasibilities Developed by SMEDA for livestock and dairy development include: an abattoir (slaughterhouse), a broiler farm of 7,500 birds, a calf-fattening farm, a dairy farm of 25 animals, a dairy farm of 50 Animals, a layer farm of 5,000 birds, livestock semen production unit, and an animal casings unit of sheep and goats.

Capacity Building of the SMEs: To overcome the deficiency of skilled manpower in the dairy sector, SMEDA has conducted training programs to enhance the capacity of the dairy farmers. Dairy is a major component of the livestock sector in Pakistan. Milk production is the least commercialized enterprise in the agricultural economy but even then it is the single largest commodity from the agricultural sector with a value of around PKR 160 billion per annum. Milk collection and distribution for the urban areas, although commercially organized, is almost entirely handled by the informal sector. Organized collection, processing and marketing of milk represents hardly two percent of total demand of the urban milk market. The milk production and distribution system suffers from many anomalies, which have diverse negative impacts on the economy in general, continuing rural poverty. SMEDA is helping introduce commercial dairy farms in the country along with establishment of related projects. We are conducting Training programs on livestock and dairy farm management in collaboration with public and private sector institutions.

Some of the training programs for the livestock/agriculture sector organized in the past were:

- Livestock and Dairy Farm Management
- Feedlot Systems
- Hygiene Milk Production
- Sheep and Goat Farming
- Poultry Farming
- Artificial Insemination

Artificial Insemination Short Course: Average milk yield is only 1,250 liters per lactation. Only 14 percent of cattle and 5 percent of buffaloes are covered by artificial insemination. The reasons are lack of trained manpower. It is estimated that 26,000 trained AI Technicians are required in 26,000 villages of Punjab province. For these reasons, SMEDA has launched one-month practical training course in Artificial Insemination at the Vocational Training Institute (VTI), Burj Attari, district Sheikupura in collaboration with Rural Development Fund (RDF) of Nestle Pakistan, and Punjab Vocational Training Council, Government of the Punjab. In this project until now 1,000 Artificial Insemination Technicians have been trained and about 80 percent of the successful candidates have started their own business in their respective villages.

Support Services for Agric Credit (SSAC): Agriculture is the life line of Pakistan economy and to bring about revolution in agriculture sector, we need to device an institutional structure and mechanism that ensures secure access of Financial Institutions to credit markets. Likewise, dairy sector should have access to commercial credit without coercive methods being employed by the State Bank of Pakistan or the government. Historically, investment in dairy, both from credit expansion and public sector development allocations has played a major role in sustained growth. Public sector allocations for agriculture in various plans have declined from 9.5 percent in the first Plan period to 1.1 percent in the 8th Plan. There are similar trends in the case of credit allocations for the agriculture sector as compared to the other sectors of economy. SMEDA in collaboration with Bank of Punjab started a pilot project of SSAC in two districts, namely Sheikupura and Okara. Now we are in the process of expansion of this project with other banks in different districts of the Punjab.

STRATEGIES FOR SUSTAINABLE DAIRY DEVELOPMENT IN PAKISTAN

- Certified bull Production scheme should be launched on a massive scale to produce progeny tested certified bulls for semen production and for improvement of Pakistani breeds like Sahiwal cattle and Nili Ravi Buffalo.
- Establishment of Livestock Breeders Organization to promote the rights of livestock voiceless farmers and involve them in policy making.
- Private Breeding Farms should be set up, with soft loan provided by the government, to produce progeny tested bulls. These farms should introduce milk-recording system.
- Livestock Services Organization (LSO) should be established in the private sector to provide veterinary services artificial insemination and animal health services to the farmers on a commercial basis.
- Revival of Sick Dairy plants (about twenty sick dairy units are waiting for their revival; Government should revive these plants through private public partnership)
- Revise Syllabus of the Veterinary courses. Our Universities and other degree awarding institutions are using old course curricula. This needs immediate attention to revise the existing out dated courses.
- Modern slaughterhouses in big cities should be established to provide hygienic meat/beef for the domestic 150 million populations and for export to the Muslim states.
- To improve the productivity of existing local breeds, the government should withdraw import duties on AI equipment.
- Pakistan does not have good laboratories for testing milk and dairy products. The establishment of such laboratories will ensure quality milk availability to consumers and proper price payment to the producers.
- All the milk-processing plants are located near big cities like Lahore. It is recommended that milk collection centers in the rural areas may be established.
- Establishment of mini dairy processing units at the doorstep of the dairy farms in the rural areas may increase the profitability of the dairy farms in the rural areas. Similarly, it is suggested that insulated milk containers should be used to transport milk from rural areas to the milk processing plants.

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3. MANAGEMENT OF DAIRY-ANIMAL FEEDING FOR BETTER PRODUCTIVITY AND FOOD SAFETY

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INTRODUCTION

Dairy production is biologically efficient system that can convert large quantities of the most abundant feed resources in Asia to milk. Of the 654 million MT of projected demand for milk in 2020 (Delgado *et al.*, 1999), the need by developing country is about 60 percent. Within Asia, South Asian countries are projected to require much more milk and milk products, representing 30 percent total global demand. To meet the projected demand, it estimated that 4 percent annual growth rate is required, but actual growth in milk production in South Asia, for example, was only 1.1 percent 1998-2003 (Ha, 2004), which clearly indicates that there is a big gap between projection and actual production in Asian dairying. Approximately 90 percent milk in Asia is produced by mixed farming systems, and the size of farms in those systems is usually small. Therefore, it is important to develop technologies needed to improve productivity of smallholder dairy farms in Asia to match the demand. Dairying has been and will be one of promising agricultural sectors because it can provide smallholder farmers not only with adequate income, but also with food security for their families.

This paper will briefly review current status and technologies on feed and feeding of dairy animals in Asia, especially by resource and technology-limited smallholders.

DAIRY-ANIMAL FEEDING SYSTEMS IN ASIA

1. Dairy-Animal Numbers, Milk Production and Efficiency

In Asia, as elsewhere, cultural preferences and market forces largely drive the development of dairy production system. Recent statistics in APO region (Tables 1 and 2) indicate that about 53 percent of milk is produced by dairy cows, and the rest 47 percent of milk is coming from buffaloes, which is characteristics of this region. In fact buffalo population in Asia represents 97 percent of global buffalo numbers (FAO, 2004).

India produces the largest volume of cow milk (46.7 percent of APO countries), followed by China, Pakistan, Japan and Korea. This largely reflects the number of dairy cows in those countries, except Japan and Korea, where more intensive production system is adopted with higher efficiency per cow. Approximately 95 percent of buffalo milk in APO region is produced in India and Pakistan, where 87 percent buffaloes are kept. During the last two decades, the volume of milk produced has in general increased, but the degree of increase varies greatly within APO countries. For instance India, Pakistan and China are countries that had a greatest increase in milk production. Currently Japan and Korea are surplus in milk, India and Pakistan are self-sufficient, and Bangladesh, Indonesia and Thailand are moving forwards self-sufficiency in the next decade or so (Devendra, 2002).

If we compare milk production per head (Table 3) between buffalo and milking cow in APO region, the former was higher than the latter. Average milk production per milking cow per year in APO countries in 2003 was 1,195 kg, but that of buffalo in the same year was 1,394 kg. Of course a great variation exists among countries. In the case of dairy cow, Korea and Japan were very high in average annual milk productivity having 7-9 times of average milk yield of APO countries. On the other hand,

the rest of countries had 2,000 kg or less annual milk yield, indicating that average daily milk yield was only 6 kg or less. India and Pakistan are two countries having higher buffalo milk yield than average. Thanks to the advancement in feeding management and various factors, there was improvement in average milk yield of cows by 59 percent during two decades. However, the improvement was negligible for buffaloes (5 percent). During the same period, efficiency in Korea was boosted by 2.5 times. India also enjoyed rather high cow milk production efficiency at 80 percent between 1980 and 2003. Increased demand driven by economic development together with human population growth, increased urbanization and internal and external support for dairy and dairy products consumption are believed to be causative factors for the increase in total yield and efficiency in these countries.

Table 1. Milk Production and Numbers of Cows in APO Region

	Cow Milk [1000 Tons (%)]			Cow [1000 head (%)]		
	1980	1990	2003	1980	1990	2003
Bangladesh	769(2.9)	744(1.7)	797(1.0)	3,735(10.0)	3,615(7.6)	3,870(5.9)
Cambodia	12(0.1)	17(0.0)	20(0.0)	85(0.2)	100(0.2)	120(0.2)
China	1,193(4.5)	4,363(9.8)	14,335(18.3)	673(1.8)	2,783(5.8)	7,007(10.7)
India	13,255(49.6)	22,240(49.8)	36,500(46.7)	25,300(67.6)	30,400(63.7)	38,800(59.4)
Indonesia	78(0.3)	346(0.8)	578(0.7)	103(0.3)	294(0.6)	368(0.6)
Iran	1,585(5.9)	2,600(5.8)	5,000(6.4)	1,863(5.0)	2,712(5.7)	4,000(6.1)
Japan	6,504(24.3)	8,189(18.3)	8,360(10.7)	1,422(3.8)	1,395(2.9)	1,210(1.9)
Korea	452(1.7)	1,752(3.9)	2,359(3.0)	114(0.3)	292(0.6)	239(0.4)
Laos	3(0.0)	5(0.0)	6(0.0)	16(0.0)	24(0.0)	30(0.0)
Malaysia	24(0.1)	29(0.1)	38(0.0)	44(0.1)	61(0.1)	83(0.1)
Mongolia	215(0.8)	271(0.6)	176(0.2)	600(1.6)	770(1.6)	848(1.3)
Nepal	190(0.7)	256(0.6)	353(0.5)	585(1.6)	689(1.4)	853(1.3)
Pakistan	2,189(8.2)	3,523(7.9)	8,620(11.0)	2,556(6.8)	4,186(8.8)	7,300(11.2)
Philippines	13(0.0)	15(0.0)	11(0.0)	6(0.0)	7(0.0)	5(0.0)
Sri Lanka	183(0.7)	183(0.4)	225(0.3)	262(0.7)	325(0.7)	330(0.5)
Thailand	30(0.1)	130(0.3)	620(0.8)	15(0.0)	44(0.1)	240(0.4)
Vietnam	26(0.1)	36(0.1)	127(0.2)	33(0.1)	45(0.1)	61(0.1)
Total	26,724	44,697	78,125	37,413	47,740	65,364

Table 2. Milk Production And Numbers of Buffalo in APO Region

	Buffalo Milk [1000 Tons (%)]			Buffalo [1000 head (%)]		
	1980	1990	2003	1980	1990	2003
Bangladesh	25(0.1)	22(0.1)	23(0.0)	63(0.2)	54(0.1)	56(0.1)
China	1,390(5.4)	1,900(4.5)	2,700(3.8)	3,475(13.2)	4,350(11.5)	5,305(10.5)
India	17,358(67.2)	29,057(68.4)	47,850(68.1)	18,000(68.4)	25,900(68.7)	34,000(67.5)
Iran	66(0.3)	121(0.3)	230(0.3)	58(0.2)	106(0.3)	200(0.4)
Malaysia	13(0.1)	10(0.0)	7(0.0)	12(0.0)	8(0.0)	6(0.0)
Nepal	500(1.9)	603(1.4)	816(1.2)	625(2.4)	747(2.0)	970(1.9)
Pakistan	6,383(24.7)	10,662(25.1)	18,520(26.4)	3,931(14.9)	6,338(16.8)	9,700(19.3)
Philippines	17(0.1)	5(0.0)	0(0.0)	29(0.1)	8(0.0)	0(0.0)
Sri Lanka	55(0.2)	64(0.2)	68(0.1)	96(0.4)	139(0.4)	105(0.2)
Vietnam	15(0.1)	24(0.1)	31(0.0)	15(0.1)	24(0.1)	31(0.1)
Total	25,822	42,468	70,245	26,302	37,674	50,373

Table 3. Milk Production Efficiency in APO Region

	Cow Milk (kg/head)			Buffalo Milk (kg/head)		
	1980	1990	2003	1980	1990	2003
Bangladesh	206	206	206	400	406	407
Cambodia	170	170	170	-	-	-
China	1,772	1,568	2,046	400	437	509
India	524	732	941	964	1,122	1,407
Indonesia	761	1,176	1,567	-	-	-
Iran	851	959	1,250	1,149	1,150	1,150
Japan	4,574	5,871	6,909	-	-	-
Korea	3,956	6,007	9,870	-	-	-
Laos	200	200	200	-	-	-
Malaysia	545	479	463	1,150	1,150	1,150
Mongolia	358	351	207	-	-	-
Nepal	325	371	414	800	808	841
Pakistan	856	842	1,181	1,624	1,682	1,909
Philippines	2,167	2,308	2,296	596	625	-
Sri Lanka	699	562	682	569	459	648
Thailand	2,000	2,931	2,583	-	-	-
Vietnam	800	800	2,087	1,000	1,000	1,000

2. Production System

There are many ways to classify dairy production systems. Most common way is probably to identify the system by the method of feeding animals, which is also related to how to obtain feed resources. In Asia, three dairying systems exist: Grazing systems, Mixed farming systems and Intensive systems.

Grazing systems: These systems are limited to parts of China and Mongolia in temperate zones and tropical highland, and also in the arid and semi-arid tropics and subtropics of some countries such as India and West Asia (Chantalakhana, 2000). Some modified, but less intensive grazing systems are prevailing in many parts of Asia, and smallholder dairying in those areas are primarily based on grazing of native pastures of low productivity, and milk production in these systems is low because livestock are primarily kept for meat (Thorpe *et al.*, 2000). Also seasonal feed availability limits the milk production in this system. During the wet season, some weight gain and milk production is achieved, which is followed by variable losses during dry season depending on grazing pressure, quantity and quality of vegetation. With high density of human population in Asia these systems will become more limited in the future.

Mixed farming systems: These systems are most prevalent in Asia, in which crop residues and by-products, and weed in cropland after harvest are used as animal feeds, while manure and draft power from animals are used in crop production. Other types of combinations are possible such as animal-tree and animal-plantation. Or more specialized systems in the case of dairying can be operational, in which purchased crop residues and mixed concentrates can be utilized when market conditions are favorable (Chantalakhana, 2000). Over 95 percent of ruminants in Asia are found in the mixed farming systems and around 90 percent of the total volume of milk is produced in crop-animal systems (Devendra, 2002). The contribution of mixed farming systems to milk production is likely to stay as the major production systems in Asia in the foreseeable future. However, there will be increasing intensification and a shift within the system.

Intensive systems: These systems are industrial systems practiced in most developed countries, and parts of East and Southeast Asia. The systems are operated with high level of feeding, management and other sophisticated modern technologies.

FEEDING REQUIREMENTS

1. Basic Nutritional Principles

Dairy cows are very efficient in converting feedstuffs into edible human foods. All dairymen should be able to take advantages of this high efficiency to maintain viable dairying. There are many recently developed modern technologies in dairy nutrition, but major portions of those advanced technologies cannot be applied directly to smallholder dairy farming unless those are transformed first to a simple form so that smallholder farmers can easily understand and apply.

Of all the nutritional principles, the most important and the key feature is rumen fermentation, and farmers must have basic understanding in this area before going into further more sophisticated nutritional areas. Application of sound rumen management itself can provide a great opportunity for milk yield improvement to smallholder dairy farmers.

Rumen microbes play key roles in supplying nutrients necessary for milk production, and maximum productivity of dairy cows is usually obtained when rumen microbial growth is maximized and rumen ecology is in optimum state. This is especially true in smallholder dairying, in which grasses, crop by-products or agric-industrial by-products are fed, and major portion of these feeds can be digested and utilized by only rumen microbes. Some of the roles of rumen microbes are: (a) Degradation of cell wall components in poor quality roughages, converting into volatile fatty acids; (b) Incorporation of simple N-compounds such as urea and ammonium salt into microbial proteins; (c) Synthesis of water soluble vitamins; and (d) Detoxification of exogenous toxins and pathogens.

In fact feeding dairy cattle is greatly simplified by the presence of rumen microbes; otherwise the animals would need better quality proteins, dietary source of B vitamins, and nonstructural carbohydrate as energy source, which are in most cases either non-available or too expensive for smallholder farmers. Anaerobic fermentation converts substrate into microbial cells and chemical product. Heat loss (5-7 percent) is probably not an important variable. Microbial efficiency is inversely related to volatile fatty acid (VFA) production, but this is not necessarily related to the efficiency of the animal host. Under the condition of technology-poor smallholder dairying systems, feeding strategy should be aimed to maximize microbial yield through the optimization of rumen fermentation. Rumen microbial efficiency, like that of the host, is affected by maintenance requirements and substrate supply above maintenance for growth. Major nutrients under practical situation of smallholder dairy systems for maximum rumen fermentation are energy, nitrogen and minerals, noticeably sulfa. It is also well known that the ratio of N and S should be around 12:1 for efficient microbial growth, and this become more important especially when large volume of NPN is supplemented.

In many cases in which cows receive low-quality crop residues especially rice straw; ruminal VFA and NH_3-N concentration is in imbalance for optimum rumen fermentation. Crop residues are high in structural carbohydrate, but low in non-structural component. Also they are low in protein. Providing both nitrogen and fermentable carbohydrate will synchronize nutrients supply and hence improve microbial fermentation in the rumen. Supplementation of urea together with small amount of molasses, fresh grasses, legumes or by-products often increases milk production via synchronization (Chanjula *et al.*, 2004). Also by-pass protein is important especially in high producing dairy animals. However, in theory for dairy animals having less than 20 kg milk production, microbial protein without additional by-pass protein will successfully support necessary protein requirement. Combining more than two feedstuffs usually results in positive response by providing balanced nutrients to both microbes and host animals (Dutta *et al.*, 2004).

2. Nutrient Requirements for Different Functions

For maintenance and production, dairy animals need to receive adequate amount of energy, protein, minerals, vitamins and water on daily basis. Some of these nutrients such as minerals and vitamins are required in very small amount. On the other hand, energy and proteins requirements are higher. It should be understood that dairy animals have different requirement for these nutrients when they are in different physiological stage. During one life cycle, dairy animals can be in the stage of maintenance, growth, reproduction, and lactation. Growth, reproduction or lactation is possible only when the amount of requirements is met. When nutrients are limited, a dairy animal will use the available nutrients for maintenance and reproduction at the expense of growth and lactation. Most dairy animals in smallholders do not reach their genetic potential because nutrient supply rarely match main-

tenance requirement. Therefore, farmers must feed their animals with more nutrients than maintenance requirements if they wish to produce milk and calves. In theory, more milk production means more economical in high producing dairy system, but this may not hold true in smallholder dairy systems where cost of high-quality feed resources is too high and in many cases farmers can not afford this kind of practice.

3. Feeding Standards

Many countries use their own feeding standards for dairy animals. These standards vary to some degrees between countries probably due to differences in breed, climate, feed resources and perhaps level of technology. Some examples of feeding standard for dairy cattle are NRC of USA (2001), ARC of UK, Japanese Dairy Feeding Standard (1999), Korean Dairy Feeding Standard (2002), ICAR of India (1998) and feeding standard used by some of EU countries. All these feeding standards basically describe physiological needs for specific functions of dairy cattle (maintenance, growth, reproduction, milk production and in some cases, draught). However, the types of nutrients specified vary among feeding standards. Some are simple in terms of nutrients specified, and some of them such as NRC are more complicated. Energy, protein, minerals and vitamins are nutrients commonly described in all the feeding standards, although units of these nutrients are different. More active research for development of proper feeding standard for local breeds with local feed resources under the local conditions are required as recently proposed by Paul *et al.* (2004). He indicated that nutrient requirements for lactating Indian cattle under tropical condition were different from those previously proposed. Simple but applicable feeding standard or even a simple feeding guide would help greatly to improve milk yield, growth of the animal, reproduction and health.

Dry matter intake is more important than anything else because there is no meaning of offering nutritious feeds if dairy cattle do not consume sufficient quantity to meet nutrient requirement. Animal, feed and environmental factors may influence feed intake. Breed type, body weight, physiological stage and level of growth and production are major animal factors, while digestibility, texture, special plant components such as tannin can be major plant factors governing dry matter intake. Effects of high ambient temperature and clean water availability on feed intake are well documented.

FEEDING AND NUTRITIONAL MANAGEMENT

Dairy Calves from Birth to 3 Months

Main target of nutritional management in this period is (a) to establish strong calf immune system and (b) to speed up development of functional rumen. The most important factor for the development of immune system is to supply sufficient amount of colostrum as soon as calves are born. It is recommended that colostrum be fed within the first 4 hours of birth and continued for the next 3-4 days with the consumption of colostrums at an amount of around 10 percent of body weight. Colostrum contains not only immunoglobulins, but is also high in nutrients and has a laxative effect. The key management practice for calf survival is feeding colostrums in sufficient amount at early time.

Calves can be fed either with dam's milk or milk replacer after the 4th day. Feeding whole milk at 10 percent of body weight during the first 3 weeks and at 6-7 percent of body weight until 5th week may result in satisfactory growth of calves. Feeding whole milk, however, is not economical when milk price is high. Calves can be raised successfully with limited milk. Calves can be fed with a commercial calf starter (around 16 percent DCP, 70 percent TDN), or good quality fodders such as *berseem*, lucerne, cowpea, or maize.

Calves at the early stage do not have functional rumen-reticulum system, the development of which is vital for efficient utilization of roughages at later stage. Energy supply via VFAs from concentrates and good quality forages is one of major factors influencing the development of functional rumen.

Growing Heifers

This is a period when dairy cattle be fed in a way that the cattle can have a sound growth of rumen, bone and body structure. Since the feed intake of poor quality fodder is low due to low digestibility (less than 1.5 percent of body weight), good quality fodder should be supplemented so that animal will gain an average of 0.8-1.0 kg/day ideally. To reach this much growth, concentrate mixture

with necessary minerals and vitamins is required. The amount of concentrate to be supplemented depends on the type of basal roughage feed. With wheat straw and some green fodders as basal feeds, around 3 kg of concentrate can satisfy the requirement of heifers at 200 kg bogy weight.

Lactating Cows

Once the lactation starts, cows should be fed for both maintenance and milk production. Therefore, proper rations should be formulated and fed accordingly. Maintenance requirements largely depend on body weight, while production requirements are dependent on the amount and composition of the milk produced. During the first period of lactation (6-8 weeks) nutrients requirements may not be satisfied due to low appetite and physiological status of the cow. High quality feeds will be beneficial for maintaining milk production and minimizing body weight loss, and ensuring rebreeding during early lactation period. Therefore best quality feeds available in the farm should be fed in this period. Cows should be fed to regain weight during later stage of lactation. For viable dairying, nutritional management should be exercised to obtain a calf every 12 to 15 months ideally, which unfortunately is not easy to be achieved by most of smallholders.

Providing universal feeding guideline for lactating cows in Asia is not possible because of great variation in animal type, body weight, average milk yield, feed availability and environmental condition. In many parts of Asia, weather is hot and humid, and feed quality is low, and therefore, *Bos indicus* cattle and buffalo having 500-1000 kg of milk per lactation may be more suitable and economical. For a cow having less than 10 kg milk production, good quality fodder such as *berseem* or green cowpea at around 70 kg can satisfy protein and energy requirement without concentrate feeding. Variety of other formulations with various local feed resources has been proposed.

Dry Cows

Ideally a dairy cow should have 300-day lactation with 60-day dry period, so that a cow can have a 12-month calving interval. Cows should build up body weight during dry period, which also allows the growth of fetus and regeneration of mammary tissue. Maintenance plus fetus growth should be taken into account in feeding management during dry period. It should be emphasized that most of crop residues such as straws would not be consumed in sufficient quantity necessary to supply nutrients for dry cows.

FEEDING RESOURCES

Availability and quality of feed resources are major constraints to milk production by smallholders, and this is often associated with the poor health status of animals (Devendra, 2000). Both availability of total dry mass and quality are greatly influenced by season, and the degree of seasonal influence varies by the region.

Types of Feed Resources

Major feed resources for ruminant animals for smallholders can be grouped into three categories: forages, crop residues and agro-industrial by-products (Table 4). Forages include grasses and legumes from pasture, roadside or any other available land, and tree leaves from both annual and permanent tree crops. In recent years, there has been increasing recognition of their potential value for ruminant animals. Crop residues are mainly fibrous materials that are by-products of crop cultivation.

Table 4. Types of Feed Resources

Type	Resources
Forage	Grasses, Legumes, Tree Leaves
Crop residues	Cereal Straws, Bagasse, Root Crop Tops and Vines
Agro-industrial by-products	Molasses, Rice Bran, Pineapple Waste, Coconut Cake Palm Kernel Meal, Cotton Seed Cake

Major ones in quantity are cereal straws, which are the main feeding resource in most parts of Asia, where crop production is major type of agriculture. In Asia, rice straw is the principal fibrous residue fed to over 90 percent of the ruminants (Devendra and Thomas, 2002). According to Devendra

(1997), 30.4 percent of rice straw is used in Southeast Asia, Mongolia and China and it has been calculated that 75 percent of rice straw from rain-fed upland and 82 percent from lowland farms are collected for animal feed.

Agro-industrial by-products (AIBP) refer to the by-products derived from the processing of the main crop. They are less fibrous in comparison to crop residues, more concentrated and therefore, have a higher nutritional value. Some of examples are molasses, rice bran, and oilseed cakes and meals.

It is extremely difficult to estimate how much forages are available in Asia. Approximately 34 percent of total land in Asia (1036×10^6 ha) can be classified as permanent grassland (FAO, 1996). Devendra (1992) estimated 199 million tons of feeds (excluding grasses) are available in Asia, and approximately 80 percent of the total feed available is potentially suited for ruminants. The amount of each feed resource available will probably vary among countries and regions within country depending on major crops produced. For instance, palm oil products and rubber seed meal are produced mainly in Indonesia and Malaysia, cocoa pod husks in Malaysia, pineapple waste in Philippines and Malaysia and cassava products in Thailand.

Nutritional Values and Harmful Constituents of Feed Resources

1) ***Nutritional values***

Soil, weather, animals and disease all influence plant growth and composition. Tropical forages are usually low in nutritional value. Summaries of reported digestibilities show that tropical forages are in average by about 15 units of digestibility lower than temperate forages (Van Soest, 1994). Also tropical forages are characterized by lower soluble carbohydrate and higher cell wall and lignin contents (Table 5). Also tropical grasses are low in metabolizable energy and crude protein (Table 6). Tree leaves are also nutritious, although they contain some high levels of phenolic compounds. Baski and Wadhwa (2004) recently indicated that of 13 tree leaves assessed, *Morus, Grewea, Ehretia and Leucaena* had great potential as animal feeds. Mulberry (*Morus alba*) is another example of tree crop which has a potential as a dairy feed. It contains high crude protein (around 20 percent) and in vitro organic matter digestibility (IVOMD) of 80 percent (Wanapat *et al.*, 2004), and maybe comparable to commercial concentrates (Patra *et al.*, 2002; Saddul *et al.* 2004).

Crop-residues and agro-industrial by-products have varying nutritional value. Good quality crop residues have a high nutritional value because of their high protein and energy value. Good examples of these types of residue are high quality oil seed cake and cassava leaf meal (Table 7). These can be used for supplementation of grasses or poor quality resources like cereal straws to improve growth and milk production. Up to 60 percent of dry matter intake of dairy cows is from crop residues in many countries. These residues exhibit low voluntary intake (less than 1.5 percent of body weight).

Table 5. Digestibility and Components of Tropical and Temperate Forages

	Dry matter basis						
	Digesti-bility (%)	Crude Protein (%)	Crude Fiber (%)	Cell Wall (%)	Lignin (%)	NFE[a] (%)	Soluble components[b] (%)
Temperate							
Alfalfa	60	17	30	40	7.5	43	33
Corn silage	70	9	24	45	3.0	61	40
Orchard grass, young	70	15	27	55	4.3	49	21
Timothy, mature	52	7	34	68	7.3	54	20
Tropical (60 days)							
Pangola grass	54	11	30	70	7.0	50	10
Guinea grass	54	9	34	70	8.0	49	9
Bermuda grass	50	9	30	77	7.0	56	8
Napier grass	50	9	31	72	8.0	50	9

Source: Riewe ad Lippke, 1970; Van Soest, 1973a, 1973b.
[a] Nitrogen-free extract
[b] Soluble components not accounted for by cell wall, protein, or ash

Table 6. Range in Nutrient Contents of Different Classes of Forages

	Metabolizable energy (MJ kg^{-1} DM)	Crude protein (g kg^{-1} DM)
Temperate grasses, hays and silages	7.0-13.0	60-250
Tropical grasses	5.0-11.0	20-200
Maize silage	10.0-12.0	60-120
Cereal straw	5.0-8.0	20-40
Root crops	11.0-14.0	40-130
Kale and rape	9.0-12.0	140-220

Table 7. Nutrient Contents of Feeds Stuffs Having Different Quality

Quality		CP (%)	ME (MJ/kg)	Ca (%)	P (%)
Good	Soybean meal	47.0	12.9	0.3	0.7
	Groundnut cake	52.0	12.9	0.2	0.7
	Cassava leaf meal	25.0	9.9	1.5	0.4
Medium	Coconut cake	23.0	12.6	0.2	0.5
	Palm Kernel cake	18.0	12.3	0.3	0.7
	Sweet potato vines	12.6	9.6	1.3	0.4
Low	Rice straw	4.5	6.0	0.3	0.1
	Palm press fiber	6.3	4.2		

Ample research results are available regarding methods for the improvement in the feeding value of cereal straws by means of physical, chemical, physio-chemical and biological treatments. In physical treatment, chopping, grinding, pelleting, soaking, steaming under pressure and gamma irradiation have been proposed. In the chemical treatment, alkali such as sodium hydroxide, acids, oxidizing reagents, ammonia and urea treatments have been shown to improve digestibility. Although some of these methods have been proven for their excellent results, no methods have been widely adopted by smallholders due to complexity of the techniques and economic reasons.

Together with feed quality, seasonal feed availability is one of the essential factors contributing successful smallholder dairy farming. Smallholders greatly depend on seasonal feed resources. During wet season, green grasses are available. However, during dry season farmers must rely on alternative feeds such as crop residues. The key elements in the establishing all year round feeding schedule are the quantification of the feed produced throughout the year and the efficiency of utilization by animals. Some of approaches proposed by Devendra (2000) are:

- Intercropping with cereal crops
- Relay cropping
- Food-feed cropping systems
- Intensive use of available crop residues
- Forage production on rice bunds
- Alley cropping
- Three strata forage system in dry land areas

Proper preservation technology such as haymaking or silage is necessary, especially when wet by-products are main feed resources, or extra amount of green fodders are available with long non-growing and slow-growing period. Sun dry and ensilaging may contribute not only for the securing of feed resources for resource-limited period, but also to the improvement of feed quality via destruction of anti-nutritional factors (Duong and Wiktorsson, 2004).

2) ***Anti-nutritional factors***

Not much information is available regarding compounds in feeds, which can give a possible human health hazard. Excessive heavy minerals in plants may be secreted into milk, but this cannot be validated unless enough data on soil characteristics and accumulation in plants are known. Also there

are some possibilities of milk contamination by fungal toxins, herbicides or other compounds derived from environment. However, these rarely reach milk and milk products, and they usually give harmful effects on animals first.

Ruminants are more efficient in using plant fiber as an energy sources than other type of herbivores due to a slower passage rate that give a longer time for microbial fermentation. The site and extent of microbial fermentation may also be important for mobilization, detoxification or neutralization of plant origin toxins or their secondary metabolites (Freeland and Janzen, 1984). Microorganisms are able to carry out many reactions for detoxification, particularly hydrolysis and reduction. These reactions are dependent on availability of energy and mineral substrates that stimulate microbial growth. Long retention time in the rumen of feed allows increased microbial action on the feed, and gives rise to higher digestibility and detoxification of plant origin toxin. Increase in the capability of detoxification in the rumen may result in proper rumen function.

Plant defenses are primarily physical and chemical. Physical defenses include spine, bark on stems, and highly lignified or silica rich tissue which are physical barrier to host animals. Lignin is the main plant factor limiting digestibility. Other components involved in plant self-protection can also limit nutritive value. Isoflavones, tannins, terpenoids and lectins are some examples. Also many of the crop residues and agro-industrial by-products contain one or more anti-nutritional factors, which may limit nutritive quality, and hence feeding regulations must be followed for maximum level of feeding to dairy animals. Various research efforts were made to reduce those compounds via plant breeding and various treatments. Some of good examples of anti-nutritional factors that may reduce feeding value are listed in Table 8.

Table 8. Anti-Nutritional Factors of Some of Non-Conventional Feeds

Feeds	Anti-nutritional Factors
Cassava leaves, peeling and pomace	HCN (17.5 mg/100 g in leaves)
Castor seed meal	Ricinoleic acid (0.2 %)
Leucaena leaf meal	Mimosine (3.5-9.2 %)
Cotton seed meal	Gossypol (0.05-0.20 %), Cycloponopenoid fatty acids
Cowpea seed meal	Trypsin inhibitor
Guar meal	Trypsin inhibitor and gum
Kapok seed meal	Cycloponopenoid fatty acids
Neem seed meal	Tannins, triterpenes
Rubber seed meal	HCN (9 mg/100 g)
Sal seed meal	Tannins (6.2-13.7%)
Water hyacinth	Oxalic acid (2.4% DM)

Tannins are probably the most studied secondary metabolite in animal nutrition because they have a profound effect on protein digestibility. And also they have potential for protection of protein against digestion in the rumen and allow dietary proteins to pass down to the lower digestive tract and subsequent digestion. Quercetin, a common phenol in many plant, depresses the growth of the ruminant bacteria *Selenomonas ruminantium*, depresses rate and maximum digestibility of nutrient in the rumen. Therefore, certain plant compounds are anti-microbial and affect digestion. A successful strategy when animals consume plant origin toxins is to increase the retention time in the rumen. Ruminants are often more resistant to plant toxins than non-ruminants because of detoxification in the rumen. A good example of rumen detoxification is that of mimosine, an amino acid in the tropical forage legume *Leucaena leucocephala* (Allison *et al.*, 1992).

FEEDING EXAMPLES

Before the type and amount of feed to be fed to a given animal is determined, some basic information such as followings must be identified.

- Type of animals
- Target level of production (maintenance, daily growth rate and milk production)

• Type of feed resources available
• Nutritive value of feed resources

Nutrients required by a certain type of animal for a specific target production level can be easily found in feeding standards such as NRC (2001), and nutritive value of available feed resources may be obtained from local or international feed composition tables. Next thing to do is simply to calculate amount of feed resources necessary to satisfy the requirement of each nutrient for specific performance by using combination of available feeds.

There are many feeding standard, which are supposed to be applied specifically to those animals of the region. One example is the standard proposed by Ranjhan (1994) or ICAR (1994, 1997). A comparison of those with other standards such as NRC or Japan and Korean ones, showed that there are no extreme differences in requirements.

If we take a dairy cow producing 10 kg milk of 5 percent fat, the animal's requirements for maintenance, for 1 kg milk production and total nutrient requirement for 10 kg milk of 5 percent fat can be estimated from Table 9, 10, and 11. Then what the farmer has to do is to estimate how much of feeds would satisfy these requirements. By rule of thumb, around 70 kg of good quality legume forage such as cowpea or *berseem* would satisfy the requirements. There could be various feeds or combination of feeds, which can supply enough nutrients for the level of milk production. When more milk production is required, then a commercial concentrate or on-farm mixed concentrate can be used. Generally, 1 kg of concentrate can support 2 or 3 kg milk increase according to milk fat percentage.

Table 9. Maintenance Requirement

Category	Body Wt. (kg)	DM Intake (kg)	TDN (kg)	CP (g)	Ca (g)	P (g)
Maintenance	350	5.0	2.60	365	14	10
	400	5.5	2.88	404	16	11
	450	6.0	3.14	441	18	13

Table 10. Nutrient Required for 1 kg Milk Production

Milk fat (%)	TDN (kg)	CP (g)	Ca (g)	P (g)
3.0	0.29	64	2.7	1.5
3.5	0.31	69	2.9	1.7
4.0	0.33	74	3.2	1.8
4.5	0.35	79	3.4	1.9
5.0	0.37	83	3.6	2.1

Table 11. Nutrient Required for 10 kg Milk of 5% Fat by a 450 kg Cow

Function	TDN (kg)	CP (g)	Ca (g)	P (g)
Maintenance	3.14	441	18	13
Milk production	3.70	830	36	21
Total	6.84	1,271	54	34

CONSTRAINTS

While the productivity of pigs and chicken in Asia has kept pace with the West in terms of the use of advanced technology and the production efficiency, dairy productivity has remained the same level for some time (Chantalakhana, 2000). As discussed, national average milk yield per cow per day is still less than 10 kg as compared to the average of 20-30 kg in developed countries.

There are definitely some solutions in technical terms but they should be carefully selected in a way that they will be suitable to smallholders. Modern technology must be assessed under local conditions and with local breeds, and then those technologies must be processed, modified and simplified for farmers to be able to adopt. Some of major constraints and/or areas needed for sustainable and profitable dairying by smallholders may include:

1. **Herd Management**
    - Proper housing
    - Water in quantity and quality
    - Vaccination/deworming

2. **Nutrition**
    - Establishment of feeding standards for local breeds
    - Basic research on nutrition of local breeds in terms of intake, rumen fermentation, digestion physiology and metabolism

3. **Feed Resources**
    - Inventory of total feed resources available
    - Quality assessment
    - Identification and detoxification of anti-nutritional factors
    - Preservation methodology (hay, silage, TMR)
    - Processing technologies to improve digestibility and to remove anti-nutritional factors
    - Information on forage production, soil, and environment,
    - Development of new feeding resources
    - Development of proper forage production systems

4. **Dissemination**
    - Training of farmers and village workers
    - Development of practical guideline for herd management, feeding and feed production

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4. SMALL-SCALE MILK COLLECTION, PROCESSING AND MARKETING – FAO ACTIVITIES

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INTRODUCTION

The Asia-Pacific region with 61 percent of the world population is a huge consumer market for dairy products. The region has the highest rate growth of demand for milk and dairy products in the world. The economic growth in the countries of the region over the past two decades resulted in improvement in food consumption pattern, which in turn, triggered increased and improved production of livestock products for food. There are characteristic variations in consumption of livestock products amongst Asia-Pacific countries. For some countries like India and Nepal, the socio-cultural norms influence the importance and preference of milk and dairy products over other foods. Fresh liquid milk dominates the Indian milk market. In contrast, consumers in most East and Southeast Asian countries consume more dairy products than fresh liquid milk. According to an estimate by the International Livestock Research Institute (1998) the global demand for dairy products is likely to increase by 60 percent and the share of the developing countries in the global consumption would be 63 percent by 2020 (Table 1).

Table 1. Projection of World Dairy Products Consumption to 2020

Global demand for dairy products to 2020:	+60%
Developing country share of global dairy products consumption:	47% (1998) 63% (2020)

Source: International Livestock Research Institute (ILRI) 1998

Table 2 shows the milk production growth rates in the region over the last ten years. Of particular interest is the development in China, where the annual dairy production almost doubled between 1992 and 2002. Significant growth is also shown in Pakistan and Thailand. These trends are expected to continue, partially due to increasing populations but also due to increased consumer demand fueled by increased incomes. Consumption levels are high in Pakistan due the large diversity of milk sweets and desserts that are an important part of the traditional national diet.

Table 2. Milk: Total Production (Unit: 1000 MT)

* - Unofficial estimate; F - FAO estimate

	Country	1992	1999	2000	2001	2002	Percent increase
			DEVELOPING COUNTRIES				
	SOUTHEAST ASIA						
1.	Cambodia	17.9(F)	20.4(F)	20.4(F)	20.4(F)	20.4(F)	1.3
2.	Indonesia	634.2	727.0	786.4	792.5	837.5(F)	2.2
3.	Lao PDR	5.5(F)	5.8(F)	6.0(F)	6.0(F)	6.0(F)	0.9
4.	Malaysia	40.5	36.1	36.4	38.8	43.7	-0.8
5.	Myanmar	532.7	606.0	618.7	633.3	651.4	2.1

(To be continued)

6.	Philippines	15.4	9.9	10.2	10.8	11.0	-3.1
7.	Thailand	177.0(*)	464.5	520.1	564.3	580.0(*)	15.2
8.	Viet Nam	60.8(F)	69.7	84.5	90.0	108.5	4.8
	SOUTH ASIA						
9.	Bangladesh	1,713.2(F)	2,095.8(F)	2,112.0(F)	2,139.2(F)	2,139.2(F)	2.0
10.	Bhutan	39.5(F)	41.4(F)	41.5(F)	41.5(F)	41.4(F)	0.5
11.	India	56,406.0	78,100.0(*)	81,000.0(*)	82,700.0(*)	85,000.0(*)	4.4
13.	Nepal	935.9	1,144.7	1,170.7	1,200.4	1,236.2	3.0
14.	Pakistan	16,280.0	27,584.0	28,355.0	29,155.0	29,999.0(F)	6.9
15.	Sri Lanka	272.2	294.9	294.5	297.9	298.0(F)	0.8
	CENTRAL ASIA						
16.	Kazakhstan	5,265.0(*)	3,576.7	3,774.7	3,968.4	4,113.8	-3.7
17.	Tajikistan	538.5	324.6	334.1	341.1	437.0	-3.4
18.	Uzbekistan	3,799.2	3,626.0	3,723.0	3,754.2	3,637.0	-0.1
	OTHER ASIA						
19.	China	8,072.5	11,244.3	12,373.7	14,490.1	14,756.7(F)	6.3
20.	DPR Korea	93.0(F)	86.0(F)	90.0(F)	92.0(F)	92.0(F)	0.3
21.	Iran (Islamic Rep. of)	4,145.0(*)	5,520.2	5,889.2	6,012.8	5,877.0	4.1
22.	Mongolia	296.3	524.0	437.6	354.3	241.6	2.1
23.	Rep. of Korea	1,821.3	2,247.4	2,257.4	2,343.3	2,394.4	2.8
	PACIFIC ISLANDS						
25.	Fiji Islands	62.00(F)	55.00(F)	56.00(F)	57.00(F)	57.50(F)	-1.50
29.	Niue	.05(F)	.05(F)	.05(F)	.05(F)	.05(F)	.01
31.	Papua New Guinea	.18(F)	.16(F)	.18(F)	.19(F)	.19(F)	.85
32.	Samoa	1.20(F)	1.45(F)	1.50(F)	1.50(F)	1.50(F)	2.33
33.	Solomon Islands	1.17(F)	1.24(F)	1.30(F)	1.30(F)	1.37(F)	1.80
34.	Tonga	.23(F)	.18	.37	.37(F)	.37(F)	5.92
35.	Vanuatu	2.30(F)	3.00(F)	3.10(F)	3.10(F)	3.10(F)	2.27
	SUB-TOTAL	101,228.7	138,410.5	143,998.5	149,109.9	152,585.9	4.4
			DEVELOPED COUNTRIES				
36.	Australia	6,941.0	10,494.0	11,183.0	10,875.0	11,610.0	5.1
37.	Japan	8,576.4	8,459.7	8,497.0	8,301.0	8,380.0	-0.2
38.	New Zealand	8,050.0	10,881.4	12,235.4	13,161.7	14,078.5	5.1
	SUB-TOTAL	23,567.4	29,835.1	31,915.4	32,337.7	34,068.5	3.5
ASIA & PACIFIC*		124,796.2	168,245.6	175,913.9	181,447.6	186,654.4	4.2
REST OF WORLD		401,491.5	402,454.7	403,799.2	407,310.0	412,032.2	0.3
WORLD		526,287.6	570,700.2	579,713.2	588,757.7	598,686.6	1.4

Source: Selected Indicators of Food and Agriculture Development in Asia-Pacific Region 2002, FAORAP

The higher dairy product intake has certainly contributed to the improvement of dietary patterns of consumers in Asia and the Pacific. The total annual dairy consumption in Asia-Pacific was 29 kg per capita by the mid 1990s. This is lower than the world average of 33 kg/head, but much higher than in the Near East and Africa.

In the context of dairy development programs, it is important to note that the Asia-Pacific region will continue to have the highest growth rates in dairy product consumption amongst all developing regions and also compared to developed countries whose dairy consumption is decreasing. This upward trend has not been markedly affected by the 1997/98 Asian economic crises and is predicted to continue to 2020.

ROLE OF SMALL-SCALE DAIRYING

Small-scale dairying can substantially contribute to sustainable rural development. Milk provides an essential source of protein, vitamins and minerals for the household (FAO, 2000). The contribution of milk is particularly important in crop monoculture. Dairying provides a small but regular income to producers. Feedback from our field-based interventions indicates that income generated

from milk marketed is used for household food needs, education and healthcare. Income generated from milk is also generally handled by the woman of the household and can therefore be considered as a sustainable element of rural food security. For the countries of South Asia milk plays a much more important role in nutrition than in any of the other regions. (FAORAP, 2002)

Smallholders make up the bulk of dairy producers of developing countries in the Asia-Pacific region. 55 million smallholders are active in small-scale dairying in Pakistan. In India for example half the national population compromise almost three fifths of the nations hungry and poor. (FAORAP, 2003) A recent FAO study also confirmed that off-farm employment generated from milk collection, processing and marketing is typically 4 off-farm jobs per 100 l of milk collected, processed and marketed with up to 10 jobs created as in the case of Bangladesh (FAO, 2003). This level of off-farm employment reflects the importance of small-scale dairying to sustainable development and rural development.

FAO AND SUSTAINABLE DAIRY DEVELOPMENT

FAO is the largest specialized UN agency for agriculture development. The Dairy team of the Animal Production and Health Division of FAO is based in Rome, Italy and has a substantial number of field projects in Asia, the Near East and Africa. Our work is focused on the small-scale dairy sector and supports and promotes sustainable small-scale dairy development. The team's strategic focus is to establish pathways out of rural poverty, build strategic alliances with key institutions and projects, and forge closer links between and core program and field level activities through activity clusters for optimum impact.

- ***Pathways out of rural poverty***: The Dairy team focuses on identifying market-oriented processing technologies and skills at the small-scale level through producer organizations. Small-scale dairying is recognized as a major contributor to rural food security and as a sustainable income generating activity. The development of a sustainable small-scale dairy sector is driven by a dynamic and market-oriented processing sector to provide firstly safe, consumer demanded products and pay competitive producers an increased price for their milk.
- ***Building strategic alliances*** with key institutions and projects is another area of focus for the Dairy team. The team has a broad range of collaborating institutions both in the Asia-Pacific region and beyond including the Animal Production and Health Commission for Asia Pacific (APHCA), Chinese Academy for Animal Science and the International Livestock Research Institute.
- The Dairy team forges closer links between and core program and field level activities through ***activity clusters*** for optimum impact. The Asia-Pacific region is one of our main target regions. FAO member countries make a large number of requests for assistance in developing the small scale dairy development sector, e.g., the government of Pakistan has recently requested FAO to include dairying as a priority component in the national FAO Special Programme for Food Security.

The team address these focus areas through the following activities:

- ***Milk producer group organizations***: Sustainable dairy development can only take place when there is a strong base of milk producers to produce milk. In many of the countries in the region there have been negative past experiences with cooperatives in dairy development. Encouraging farmer's participation in farmers groups, associations or cooperatives is therefore a challenge but an essential part to improving the competitiveness of small farmer participation in growing market opportunities.
- ***Dairy Institutions set up and development*****:** There has been an increasing withdrawal of governments away from involvement in milk collection, processing and marketing activities in the region. This represents both a challenge and opportunity for the small-scale sector, market demand is growing (FAO/ILRI/IFPRI, 2000) but market tailored products are required. Small-scale farmers can be highly competitive (FAO, 2003) in the region in dairying but only when they can supply safe quality products to meet market demand.

  The design and set up of dairy development institutions is one of the key demand areas for FAO interventions. FAO has unique field-learned experiences in this area gathered from all over the

world. In collaboration with responsible national dairy authorities or boards and using a market-oriented dairy approach we promote and facilitate the participation of smallholders dairy farmers to meet growing consumer demand.

Through provision of technical advice and strategy level interventions can provide governments of the region with pathways out of poverty. There is however much to be learned from previous project approaches and lessons learned in the Asia-Pacific region. We base our interventions and advice on these lessons and success stories.

- ***Low cost milk collection, processing and marketing equipment*:** One of the main limitations to the uptake and transfer of technologies by small and medium scale dairy development are the cost and complexity of milk processing technologies. There have been significant developments in technologies for milk processing since India started Operation Flood. Availability of affordable small to medium scale milk processing equipment is perhaps the key-limiting factor to the entry of small to medium scale processors and milk producer groups. These entrepreneurs and groups do not have the capital resources to invest in expensive equipment. This limited their ability to produce and package market demanded products.

  India and Thailand are two of the key countries in the Asia-Pacific region where there are highly competent metal fabrication and engineering workshops – the essential elements to produce low cost milk processing technologies. India for example, through the growth of demand for milk and milk products now manufactures 95% of dairy equipment used by National Dairy Development Board Co-operatives (NDDB). This is however the exception rather than the rule in the region.

- ***Capacity building in sustainable milk processing*:** There is a shortage of qualified milk technology and food engineering personnel in the region. One of the reasons for this is historical and has been exacerbated due to high growth rates in demand for dairy products.

  There is currently no regional dairy training institution, which neither offers nor can meet the requirements of growing milk industries. This lack of expertise is also a limiting factor for participation in growing markets by small and medium scale milk processors. An important element of this training is the need for a market-oriented approach, which enables entrepreneurs to recognize and respond to market, needs.

FAO ACTIVITIES

FAO has contributed to a number of interventions in small-scale dairy development in the region. The most well-known example was Operation Flood in India in which FAO provided technical support and advice on monetization of dairy commodities and sustainable dairy development. India is now the second largest milk producer in the world and is exporting milk and dairy products including milk powder, primarily to the Arab Gulf states.

FAO continues to support and advise on sustainable dairy development in the region using a market-oriented approach. We currently have field projects in Bangladesh, (three in total) Myanmar, Thailand, N. Korea, Mongolia and Sri Lanka.

In Bangladesh, the Dairy team is providing technical advice to the United National Development Programme funded and Grameen Motsho foundation executed project entitled “Community Livestock Dairy Development Programme”. Small-scale dairying is the core income generating activity and therefore driving force for sustainable development. The project provides a complete livestock package to landless people having an income level of less than US$0.40 per day.

Working with the Department of Livestock Services FAO is also funding a pilot small-scale milk processing unit at the Savar Dairy Farm, located some 20 km outside Dhaka. This provides the skills and low-cost technologies needed by small and medium scale processors in Bangladesh. By providing livestock policy support FAO is also promoting the long-term sustainable development of the valuable livestock sector.

FAO is one of the few organizations active in Myanmar. In collaboration with the Livestock, Breeding and Veterinary Department a pilot milk processing plant has been set up. Training of small-scale processors has started with both imported and locally produced dairy processing equipment. Milk producers and processing cooperatives have been set up and are operational.

Mongolia has one of the harshest climates in the Asia-Pacific region. Livestock and livestock products are a vital part of the livelihood of Mongolians with milk and dairy products. With the support of the government of Japan and in collaboration with the Ministry of Food and Agriculture of Mongolia, FAO is leading the recovery and development of sustainable small-scale dairying in Mongolia.

A regional project on alternative systems of milk collection was also recently completed which covered Bhutan, The Philippines, Vietnam, Pakistan and Indonesia.

Some of our partners in the regions include the Grameen Bank and Grameen Motsho Foundation in Bangladesh, the Chiang Mai Dairy Training Center in Thailand, the National Dairy Authority in the Philippines, the Animal Production and Health Commission for Asia Pacific and the Japan Livestock Technology Association.

CONCLUSIONS AND RECOMMENDATIONS

1. There is a need and opportunity to improve the participation of smallholder dairy farmers in growing dairy markets.

   With a solid track record FAO can play a lead and independent role in improving the role and income levels of smallholders farmers by working with national governments and responsible dairy development authorities. During the 28th session of the Animal Production and Health Commission for Asia Pacific FAO was mandated to develop a regional initiative ("Dairy Asia") on market-oriented dairy development.

2. Sharing of experiences and skills in the region can be best accomplished by a regional organization. APO has the mandate and ability to meet this need. Based on our expertise and lessons learned in the region it is proposed that FAO and the Asia Productivity Organization explore opportunities for developing a regional dairy initiative. The initiative will focus on developing and using regional expertise. This can sustainably improve the ability of small and medium scale milk processors to react to market demands by using economically sustainably and competitive local milk to provide consumers with quality dairy products and provide increased returns to smallholders.

3. Limitations of availability of low-cost suitable dairy equipment and processes are limiting market participation by small and medium scale processors. Given the technological and organization innovations in the region it is proposed that the initiative source the bulk of required technical expertise regionally and promote regional sharing of experiences. Participation by advanced dairy nations in the region in the provision of capacity building and improved low-cost technologies will substantially contribute to the success and impact of the initiative.

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5. COST EFFECTIVE TECHNOLOGIES FOR MILK PRESERVATION AND PROCESSING BY DAIRY SMEs

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INTRODUCTION

Pakistan, the 5th largest milk producer in the world, produced an estimated 28.6 million tons during 2003-04. Of this, 98 percent was traded as raw milk of which 50 percent was used as fresh or boiled milk, 15 percent as yogurt (*dahi*') and the balance converted into varieties of indigenous milk products such as sweetmeats, ice cream, butter, *khoya, rubri, kheer,* cheese, etc. Bulk of milk is produced in rural areas and is consumed in urban areas. Pakistan's per capita consumption of milk is around 151 liters per year, which is much lower than many other Asian countries. Despite the premium status, Pakistan has not been able to consolidate its benefits. Therefore to meet the demand of urban consumers, dried milk and milk products valued at about PKR.700 million per year are imported.

Milk plays a major role in reducing poverty and is a source of nutritious food in rural and urban population. For the small-scale producer milk is a key element for household income and food security. Milk is a regular source of income for rural families and their survival. In remote villages where small farmers have no direct access to market, middlemen take the biggest share of the consumer price.

Raw milk can be a carrier of disease causing organisms. The modern dairy processing plants have made the consumption of milk safe and pathogen-free. A survey conducted by the Animal Husbandry and Veterinary Sciences, Agricultural University Peshawar, revealed that loose milk is a source of various diseases because milk is produced in filthy housing system, unhygienic management, unclean milking, dirty utensils for storage, transportation and marketing and unclean water used as source for adulteration. A number of studies revealed that adulterated milk is the main carrier of dangerous pathogens causing tuberculosis, polio, and typhoid. This can be avoided through clean milk production, prompt chilling and processing raw milk by boiling, pasteurization and UHT treatment before consumption and through strict implementation of food laws for quality assurance.

Milk consumption patterns have shown a steady shift towards packaged milk as more people realize its health and packaging benefits. The total share of packaged milk has grown from 0.96 percent to 5 percent in just four years. Packaged milk assures the consumer of being fresh, high quality, easier to carry and transport. Changing lifestyles have also influenced innovative variations in packaged milk, such as low-fat, skimmed and flavored milk.

In Pakistan milk processing on modern lines started in early 1960s. Between 1960s and 1970s, 23 milk pasteurization and sterilization plants were established, mostly in the private sector. Besides processing fresh milk these plants used to recombine skimmed milk powder and butter oil received under the FAO World Food Program. These "first generation dairy plants" were not successful and had to be closed down, except the one in Lahore. Their failure was primarily due to poor acceptance of recombined milk and the short shelf life of pasteurized milk. Other factors responsible for their failure were: lack of qualified technologists, inadequate supply of fresh milk and poor management. The "second generation dairy plants", the first one being set up in 1977, produced ultra high temperature (UHT) milk.

The milk processing industry is facing an unhealthy competition from *gwalas*, the local milk traders. They are consumer friendly, supply milk at doorstep, give credit for one month and price their product according to the whims of the housewife. The organized dairy industry has to charge for cost of production, procurement, packaging, transportation, distribution and publicity. During 2004, only 17 milk plants were in operation and processed not more than 2 percent of total milk production. The processing capacity of these plants was around 0.65 million liters per day including 0.43 million liters of UHT and pasteurized milk.

CONVENTIONAL AND NON-CONVENTIONAL TECHNIQUES FOR MILK PRESERVATION AND PROCESSING BY COTTAGE INDUSTRY

Background

Milk can be transported un-refrigerated for a short distance and duration. Within 5-7 hours of milking, it begins to sour and becomes useless. Worldwide, liquid milk dominates in processing, marketing and consumption. Liquid milk is sold as farm-fresh raw milk in poor developing countries and as pasteurized or UHT milk in countries with developed dairy industries. In the economically developed European and North American countries, the share of liquid milk is dwindling. Over the last thirty years share of liquid milk has dropped from 70 percent to no more than 50 percent as more and more milk is directed towards such products as fermented milks, cheese, butter, dried milk, etc. Processed and packaged liquid milk is still the most important base for developing the dairy industry in developing countries.

Traditional Milk Products

Milk occupies an exalted position in Indo-Pak subcontinent. Its roots go back to some 6,000 years when milch animals were domesticated. Simple processes were developed to preserve nutritive quality of milk to protect and promote health. To prevent milk from spoilage the surplus milk was converted to a number of products, e.g., *dahi* - yogurt-like fermented product, *makkhan* (butter), *khoa* (partially desiccated milk), *chhanna* and *paneer* (cultured soft cottage cheese-like product) and *ghee* (clarified butter). A wide range of sweets was produced for consumption on festive occasions. They included *rusgulla, burfi, peda, shrikhand, gulabjamun, lassi, and kheer,* combining delicious taste and flavor with fitness and health. These ethnic products constituted the world of traditional dairy products. The milk handling practices, as developed in the older times, from producer to consumer were based on simple approach and science and were handed down from generation to generation to serve home, smallholder and trade. These were low-cost, appropriate and sustainable. Modernization and application of technology to produce these traditional products will also result in energy saving. For example, evaporation of milk in a *karahi* consumes five times more energy than the modern vacuum evaporator. The increasing demand for traditional products presents a great opportunity for the organized dairy sector in the subcontinent to strengthen its base and consume a larger share of the expanding milk production.

Small Scale Processing in Developing Countries

Many developing countries are joining or preparing to join the World Trade Organization. As the developing countries open, their markets would be flood with better quality, better packed and competitively priced products. This can adversely affect the small-scale agribusiness including the dairy industry. Do these countries want their small-scale agribusiness to sustain or vanish and be replaced by the imported products'? To safeguard their interest, to alleviate rural poverty and generate rural employment, the developing countries should make a definitive policy statement on sustenance of small-scale agribusiness.

Small-scale processing units are usually those handling more than 500 liters but less than 5,000 liters of milk per day. Very small scale or micro-dairies are those handling less than 500 liters per day. At the very bottom the technologists ought to underline "household level technologies" for food security and household processing of milk. The definition of small scale in one country may be medium scale in another, depending on the level of development. Besides this is influenced by the availability of local technology.

Increased consumer awareness is increasing demand for safer and more hygienic products through application of technology. Small-scale processing technologies used by entrepreneurs vary across agro-ecological zones and according to consumer demand. Most small-scale technologies are traditional or semi-traditional and being upgraded with influence of modernization. Their products have to compete with the large-scale or multi-national corporations. In developing countries, the small-scale processor does not have access to training even if he is ready to pay for learning. Most small-scale entrepreneurs start processing by tradition without formal skills and they put their business to market risks.

The Lactoperoxidase System (LPS) for Milk Preservation

If milk is boiled before consumption, as is the practice in many Asian countries, there is no need for processing. But if the milk is sold in a distant market it requires some kind of preservation. In

many developing countries cooling milk at the village level is difficult because of the non-availability of reliable power supply and other cost factors. Without preservation milk would deteriorate and the producer would suffer heavy loss of food and value. The World Bank has estimated that 20 percent of milk produced is wasted in developing countries. The use of LPS can help collect milk from small producers who do not have access to infrastructure for milk cooling or processing. The LPS is cheap, easy to use and requires minimum training. It is neither an alternative to pasteurization nor a replacement for precautions and practices to hygienic production of standard milk. It is a processing aid to enhance the naturally occurring antibacterial system in milk.

Research in Sweden on colostrums in the 1960's led to the discovery of a naturally occurring enzyme called Lactoperoxidase. The LPS is activated in raw milk by adding 10 parts per million of thiocyanate, preferably in powder form. The solution is thoroughly mixed for 30 seconds and then equimolar, 8.5 parts per million of hydrogen peroxide is added, generally as granulated sodium carbonate peroxyhydrate. The activated LPS has bacteriostatic effect on raw milk and extends its shelf life at 30° C for 7-8 hours; at 25° C for 11-12 hours; at 20° C for 16-17 hours and at 15° C for 24-26 hours.

After 15 years of field experiments in developed and developing countries, a Code of Practice to use LPS for milk preservation was approved by the FAO/WHO Expert Committee on Food Additives in 1989 and by the Codex Alimentarius Commission in 1991. The Codex Alimentarius Commission has recommended that LPS be applied in the following situations:

i) The method should be used only in situations when technical, economical and/or practical reasons do not allow the use of cooling facilities for maintaining the quality of raw milk.
ii) Individual farmers should not use the LPS. It should be used at a collection point/center equipped with facilities for cleaning and sanitizing the vessels meant to store and transport milk.
iii) A person responsible for the collection of milk should be in charge for the treatment of milk with LPS. They should be given appropriate training in use of LPS and in general milk hygiene.
iv) The main dairy plant collecting the LPS-treated milk should ensure that the method is used as intended.
v) The method should be used to prevent undue bacterial multiplication in raw milk during collection and transportation to the dairy processing plant.

The United Nations Development Program (UNDP) is financing an FAO project in China, in which 5 million liters of milk a day is treated by LPS, and has introduced it in Mongolia, North Korea and South Korea. A total of 80 countries have registered their interest in participating in the FAO Global Lactoperoxidase Program. FAO, with the support of the Swedish, Irish, Hungarian and Czech Governments is promoting use of LPS as a safe and effective method of milk preservation.

TECHNOLOGIES FOR SMALL-SCALE LIQUID MILK PROCESSING

A stepwise scaling up of technologies is essential for any country wishing to grow a successful dairy industry. Unfortunately, simple solutions are either not always available or are ignored in favor of more sophisticated processing equipment which may not always be appropriate for specific situations. For anyone trying to develop or set up a liquid milk-processing unit, one cannot avoid considering the following:

Milk Cooling and Collection System

For on-farm small-scale processing and for collection of milk from many small-scale milk producers, there is a need to develop most appropriate and efficient method of cooling and collecting milk. The immersion coolers are the simplest technique available for developing dairy industry. Milk is cooled in individual milk cans and helps to avoid mixing of inferior milk from a supplier into the rest of the milk. In the event of electricity breakdown, the ice bank provides a buffer to keep milk in good condition for several hours. A mechanical engineer or a technician trained in knowledge and use of compressor, condenser, copper pipes for an evaporator and other essential standard components of a refrigeration system, can construct an ice bank. Despite availability of such a simple technology, the dairy industry in Pakistan has generally favored the use of imported, stainless steel direct expansion vat.

Milk Separation

Milk separation is a necessity for anyone trying to optimize profits by producing butterfat-standardized milk. The excess butterfat may be converted to value added products such as cream, butter

or ghee. The manual and electrically operated centrifugal cream separators of 50 liters 500 liters per hour are available from various manufacturers.

Milk Homogenization

Homogenization of milk is standard operation for commercially processed milk. Homogenization has the effect of breaking down the fat globules to sizes so small that the milk fat will not form into a creamy layer. This improves the organoleptic and physical properties of pasteurized milk. To some consumers homogenization is a disadvantage because it does not allow cream layer formation and take it as fatless milk. Such consumers prefer raw milk. Homogenizers are very expensive and the smallest unit of 250-300 liters per hour may cost as much as US$ 15,000. Use of a homogenizer is not economical for processing less than 5,000 liters per day.

Milk Pasteurization

***Batch Pasteurization*:** Milk may be pasteurized in a batch by use of the age-old double-jacketed stainless steel vat. Schulthess (1995) described a cheaper version, fabricated in Kenya, made of stainless steel inner vat and a mild steel outer jacket and operating on low-pressure steam. In-can pasteurization of several hundred liters per day may be done in brick lined charcoal/firewood stoves. Agrawala (1997) described a mini-jacketed kettle with a double jacket filled with water that is heated by use of an electric element. The milk is filled and heated to any desired temperature and holding time. The excess steam generated is whistled out from a vent as a caution to the operator to control the pasteurization temperature of the milk. Batch pasteurizers may easily be constructed by any mechanical engineering workshop with capability for stainless steel welding and metal sheet work facilities.

***H.T.S.T. Pasteurization*:** High Temperature Short Time mini-pasteurizers are based on plate heat exchanger technology. They are sophisticated in their design and construction. The smallest units have capacities ranging from 500 liters per hour. This helps in continuous pasteurization of milk in large quantities. Major dairy equipment manufactures have many versions.

***In-container Pasteurization*:** Milk may be pasteurized after filling in the marketable container – a plastic sachet or a bottle. The containers are filled and placed in a hot water bath or spray with or without agitation. The batch pasteurization is usually done at 63-65^{o} C for 30 minutes. Batch pasteurizers are available in capacities to pasteurize up to 2,000 liters per day with manual plastic sachet sealing machines of up to 300 sachets per hour. Sachets are usually pre-formed and sealed on one end. Milk is filled with manual, semi-automatic or fully automatic machines. Unlike the pre-formed sachets, the fully automatic machines form, fill milk and seal the pouch. Automatic versions provide facility for disinfecting the plastic film before milk is filled in. Batch pasteurized milk may also be filled in plastic or glass bottles or 3-5 liters plastic gallons and capped with aluminum foil, screw or cork cap.

Bulk Vending

After batch pasteurization and cooling milk may be sold in bulk via bulk vending machines. This system is successfully in use by Idara-e-Kisan in Pakistan and by many dairies in India. It cuts down the cost of single use packaging.

Milk Storage and Transportation

Pasteurized milk has to be kept cold throughout the marketing chain. Hence provision for refrigerated storage is mandatory. Transportation and distribution has to be done in insulated vehicles to avoid excessive temperature increases.

CHALLENGES AND OPPORTUNITIES FOR DEVELOPING AND DISSEMINATING TECHNNOLOGIES FOR SMEs

Rural producers of milk, whether small or large, do not have any facility to process milk. They directly or through middlemen perforce sell raw milk to the major urban centers. This reduces their ability to bargain better price for milk. While large-scale processing plants are available, the challenge for the developing countries is to miniaturize these technologies to small-scale modules of up to 5,000 liters per day. Small-scale processors often have no access to information on models, capacities, price and source of equipment.

Government policies in the developing countries should establish regulatory framework to safeguard the small-scale processors, and equipment manufacturers, which are playing a key role in rural poverty alleviation and employment generation. The real agenda for future strategies must address the training and human resource development, appropriate trade barriers, rational local taxes and import duties on equipment, accessibility to the information on appropriate technology, legal standards and other relevant issues affecting the development of small-scale agribusiness.

The government may seek collaboration with the FAO and other international and regional partners to seek technical guidelines for development of low cost and small-scale milk cooling and processing equipment. These should be developed and promoted through regional dairy training institutions. The government may prepare a directory of national and international suppliers of low cost small-scale dairy equipment.

To optimize the use of technology the best option is to set up milk producers' organizations that can scale up their milk collection, processing, product development and distribution system. As an organization they can improve safety, quantity and quality of milk and dairy products to the consumers. The government and the private sector should inform consumers on the potential hazards of consuming raw milk and dairy products.

SUCCESS STORIES

Use of LPS

FAO project for preservation of milk at rural levels has been successfully implemented in China, Mongolia, North Korea and South Korea and Pakistan.

Low Cost Packaging-Pasteurizing-Chilling System in Kenya

In collaboration with the FAO (Government of Kenya/FAO Project TCP/KEN/6611), a low cost, pasteurizing and packaging system was field-tested and successfully adapted at the Naivasha Dairy Training Institute for use by groups of small farmers. The producer groups benefited by marketing the value added extended-life milk, both locally and to nearby urban centers. The system will soon be used in more than ten countries. The system was developed in South Africa and was known as the MILKPRO. It comprised filler that gravity fed raw milk into pre-formed sachets. The sachets were manually sealed and placed in a batch pasteurizer. They are treated at 65 degrees centigrade for 30 minutes. The heating process was automatically controlled. After pasteurizing the sachets were cooled to 5^{o} C in a chilling unit.

The system is operated at 240-volt electrical power. It is designed for easy cleaning and maintenance. Post pasteurization contamination is minimized by refrigeration. The shelf life of milk under refrigeration is up to two weeks compared to the HTST pasteurized milk of 2 to 5 days. Since the pasteurization temperature is lower than the conventional systems or boiling, the milk retains its 'fresh from the cow flavor'. The MILKPRO system can handle up to 100 liters of milk an hour. It costs under US$10,000 plus freight. At a daily throughput of 750 liters, the payback period was 12 months.

Case Study: A Brazilian Dairy Co-Operative

The Co-operative Agropecuaria de Boa Esperança Ltd. (CAPEBE) located in Minas Gerais, Brazil, has successfully developed a milk collection program among its farmers, 80 percent of them producing an average of 100 liters per day. The key of the program is the common cooling tank. CAPEBE operates nine common cooling tanks, and four more are in the process of installation. The process of cooling has reduced milk rejected at reception from 140,000 liters in 1997 to 16,400 liters in 1999. There was dramatic reduction in transport cost by 80 percent. For example, in some places, the transport cost per liter went down from US$0.022 to US$0.007 per liter.

Before the use of common cooling tanks, the tanker traveled 90 km to load 1,000-1,200 liters per day. After installation of common tanks the tanker circuit reduced to 58 km and loaded 6,500 liters of milk every two days. In addition reducing the transport cost and travel time, it has improved the quality arriving at the dairy dock.

At a price of US$5,155, each cooling tank has a capacity to store 2,500 liters of milk. The farmers use the financing offered by CAPEBE that allows interest free repayment in 15 months. The tank invoice goes to one of the associated farmers, but all of the farmers authorize CAPEBE to discount the payments from their milk payment.

India: Leader in Traditional Milk Products

In recent years, some outstanding innovations have been made at the National Dairy Development Board (NDDB) and the National Dairy Research Institute (NDRI) for the assembly-line production of *burfi, dahi, kheer, shrikhand, gulabjamun, rusgulla,* and the like, by adapting the modern machinery and technology. An admirable example is that of adapting western technology to manufacture *shrikhand* on a large scale. The process used basket centrifuges, separators and planetary mixers used by bakeries. Today, the volume of *shrikhand* manufactured by the organized sector exceeds that of processed cheese sold in India. The manufacture of *khoa*, using roller driers and scraped surface heat exchangers, is another instance of the use of the modern technology. These technologies can also be used for *chhana* making and concentration of milk for many indigenous dairy products. The use of meatball forming machines and potato fryers for manufacturing *gulabjamuns* on a large scale is a good example of integrating the traditional with the modern. Packaging of these products can also follow a similar approach. In Italy, Mozzarella cheese balls are being packed in whey in consumer packs. This can be tried to market *rusgullas* and *gulabjamuns.* Chocolate and candy packaging lines can be used to pack *burfi and peda*. Tetrapaks can be used to pack *lassi, kheer* and *sevian.*

India's most modern plant for traditional dairy products is that of the Baroda District Cooperative Milk Producers Union Ltd. (Sugam Dairy) at Vadodara in Gujarat. It markets its products through a large network of hundreds of retail outlets in the city. The Sugam Dairy uses the traditional retailers of grocery and general stores that have a refrigerator to market its products. The product range includes *shrikhand, gulabjamuns, pedas, curd*, and flavored milks. The dairy has the highest turnover in marketing traditional dairy products. Dairies in Punjab and Haryana market *lassi, paneer kalakand, and* milk cake. Cooperative dairies in Tamil Nadu, Andhra Pradesh and Karnataka also sell *makkhan, khoa, peda* and *kulfi*. Gokul, Mahanand and Warana dairies in Maharashtra are also marketing *shrikhand* through their sales outlets.

Milk Vita in Bangladesh

'Milk Vita' is the brand name of the Bangladesh Co-operative Milk Producers Union Ltd, Dhaka (BDCMPUL). The BDCMPUL has developed after a painstaking technical and financial assistance given for 30 years by the Government of Bangladesh and other donor agencies. The government fixed the import tariff on milk powder to support the development of local dairy industry in particular Milk Vita.

In the late 1960's, two loss making dairy organizations were amalgamated by the Government to form the Eastern Milk Producers Co-operative Union Ltd (EMPCUL). It used 'Milk Vita' as a brand name for its products. In the mid 1970's, the Government of Bangladesh initiated a co-operative dairy venture with the financial and technical assistance from UNDP, FAO and DANIDA. Three chilling plants and one pasteurization/processing plant were commissioned in rural milk pocket areas. One processing and packaging plant was set up in Dhaka city for standardization of liquid milk and marketing of pasteurized milk and milk products to the city dwellers.

In 1977, the name of the organization was changed to Bangladesh Milk Producers Co-operative Union Ltd. Initially the BDCMPUL started its activities in 110 village primary co-operatives having 4,304 household members in four districts, procured 0.85 million liters of milk and paid Takka 1.85 million to the producers. In spite of increased milk collection, the co-operative was making loss. From 1991-92 the Union has turned around and made profits. In 1997-98 Milk Vita made a net profit of Takka 47.8 million (US$1.0 million) on a turn over of Takka 490.5 million (US$10.0 million). The profit was distributed as a dividend to the milk producers. The unions financed from its earning installation of four additional chilling centers and one instant milk powder plant of 100,000 liters per day. The current daily milk collection quantity is 115,000 liters and sale volume is around 90,000 liters. The direct beneficiaries of this co-operative organization are 40,000 landless, small and marginal household milk producers of 390 village primary milk co-operative societies (VMPCS). Other beneficiaries are 300,000 family members, 800 employees of VMPCS, 300 rickshaw pullers of Dhaka city engaged in milk transportation to the retail shops and 700 employees of different dairy plants and Head Office and millions of city consumers.

The important factors that have contributed to the success of the Union were the empowerment of the Board and the appointment of professional in the top management. Since 1991, Board of Directors elected from amongst the VMPCS has governed BDCMPUL. The Board paid fair milk price to the

producer members, ensured timely procurement of milk, provided required support services to enhance milk production and was active role in business development plan.

The BDCMPUL provided such support services to its member as: (a) training and study tours of the producers at home and abroad enhancing their knowledge on modern cattle management for increased milk production, (b) distribution of incentive bonus, additional price to the producers and special prize to the co-operatives to stimulate milk production, (c) accountability of employees to the producers through the Board.

To build up its brand "Milk Vita" in the market the BDCMPUL practiced strict quality control at producer's level and in processing plant; ensured timely distribution of quality pasteurized milk and other dairy products to retailers and consumers of greater Dhaka and other cities; used locally fabricated Milkshaws - insulated boxes, mounted on a traditional three-wheeled cycle rickshaws, to deliver milk and milk products in the narrow, congested streets.

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1. BANGLADESH

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INTRODUCTION

Livestock is an important component of socio-economic fabric of Bangladesh. This sub sector is integrated into existing farming system and linked directly to crop production, fuel supply, nutrition, farmer's income and welfare. The livestock and poultry population of the country is very high and are mainly reared by small-scale farmers. Dairy generates regular cash income, provides nutritional security and creates more job opportunities in production, processing and marketing per unit value added than agriculture and crops (Asaduzzaman, 2000; Omore *et al*., 2002).

Bangladesh has non descript cattle that have poor milk productivity. In 1936, Lord Linlithgo, the then Viceroy of British India distributed some Hariana bulls to the farmers of Pabna, Serajgonj, Madaripur, Faridpur, Gopalgonj, Rajbari, Shariatpur, Manikganj and some parts of Dhaka districts for natural service so as to improve the genetic quality of local nondescript cattle (Table 1). In 1958, artificial insemination centers were set up at Dhaka, Chittagong, Rangpur, Rajshahi and Jessore. In 1959-60, the Central Cattle Breeding Station (CCBS) and dairy farm was established at Savar, near Dhaka. In 1975-76, artificial insemination program was taken up nationwide.

Table 1. Bangladesh at a Glance

Area	144,000 sq. km
Population	130 million
Population growth rate	2.4% per annum
Cattle population	23.5 million
Cattle growth rate	0.8% per annum

The dairy industry in Bangladesh started growing remarkably from the beginning of 1990. The number of dairy farms increased from 2,490 in 1990-91 to 29,600 in 1997-98 (Anon, 2000). More dairy farms are establishing every year and some are opting out. Milk production has increased from 1.29 million metric tons in 1987-88 to 1.74 million metric tons in 2001. Consequent to increase in milk production, import of milk powder has declined from 55,000 MT in 1991-92 to 17,000 MT in 2001.

FARMING SYSTEMS IN BANGLADESH

Dairy farming in Bangladesh is practiced as: subsistence dairies, market oriented dairies and commercial dairies. An economic opportunity survey (EOS) on 1,444 dairy farms representing four types of farming systems in different areas of Bangladesh was carried out to rank the management factors for improving financial performance of the farms and for economic savings. Farms under Mymensingh, Khulna-Satkhira, Sirajgonj-Bera and Chittagong respectively represented the subsistence type dairies, small holders market oriented dairies, pocket dairies and small holders dairies in the hilly areas (Table 2).

About 68% of village families practice dairying as subsistence to cropping and a family on an average produces 8.3 liter of milk in a week. Average daily milk production is 0.8 liters per cow (Haque, 2002). The milk is marketed rurally and consumed at home. Milk price is very unstable and is not remunerative to the producer.

Milk producers in rural areas that are close to cities and towns get a higher price for their milk. These farmers keep crossbreds of Friesian and Sahiwal or high quality Sahiwal cattle and practice intensive management.

There are certain potential areas in Bangladesh that support higher milk production and the farmers practice intensive feeding of cultivated fodder. Historically, these farmers keep cattle of better germplasm. Baghabari milk shed in Serajgonj district is a typical example. It was observed that the average herd size varied according to the area. Highest being in Sirajgonj followed by Chittagong. In actual fact these are produce significant milk production and the animals have comparatively high productivity.

Study also showed that the farming systems and areas where the productivity of animal was the highest also had significantly lower cost of feeding as compared to the total income generated from dairying and the share of milk sold to produced was higher perhaps because these area produced more milk than could be kept for home consumption. Thus Sirajgonj and Chittagong have more commercial orientation of dairying than Mymensingh and Khulna (Table 3).

According to the survey increase in milk production and per animal productivity could be achieved by increasing lactation length, decreasing age at first calving, decreasing calf mortality and decreasing calving interval (Table 4). These factors also determined the expenses (Table 5). It was found that in all cases feed cost was the component that added to the cost of milk production. The next most important cost was on labor. In any case all these expenses were the lowest in areas where milk productivity was the highest.

Commercial Aspects of Dairy Farms: The study showed that the milk production cost is greatly influenced by productivity of the milking animal. The cost of milk production decreased as per cow daily milk production increased. To maintain the production cost at US$0.20, it was necessary to have a cow that produced at least 8 litres or more milk daily.

Table 2. Farming Systems: Average Herd Composition

Inventory (Number)	Mymensingh	Khulna-Satkhira	Sirajgonj-Bera	Chittagong
Farms	434	311	412	287
Lactating Cows	1.5	2.2	3.4	2.7
Mature Cows	1.9	2.8	4.2	3.5
Replacement Heifers	1.5	2.1	2.7	2.6
Male Cattle	1.2	1.4	2.5	1.9
Total Head	4.6	6.3	10.5	8.0

Table 3. Farming Systems: General Management Indices

Management indices (%)	Mymensingh	Khulna-Satkhira	Sirajgonj-Bera	Chittagong
Feed Cost: Income	60	80	50	50
Milk Sold: Produced	78	84	90	81
Lactating: Mature Cows	87	84	80	82
Lactating: Total Herd	36	38	30	34

Table 4. Farming Systems: Health, Production, and Reproduction Indices

Management indices	Mymensingh	Khulna-Satkhira	Sirajgonj-Bera	Chittagong
Calf Mortality (%)	4	9	10	10
Age at First Calving (months)	44	39	40	34
Calving Interval (months)	18	15	14	17
Lactation Length (days)	284	256	247	288
Milk Production (liter/day)	3.0	4.0	7.0	4.5

Table 5. Farming Systems: Cost Components (Tk/liter)

Cost Component	Mymensingh	Khulna-Satkhira	Sirajgonj-Bera	Chittagong
Health Care Cost	0.02	0.17	0.11	0.25
Feed Cost	10.91	10.79	7.28	9.50
Labor Cost	5.87	3.47	2.03	5.50
Housing Cost	0.23	0.28	0.23	0.34
Milk Production Cost	18.16	14.80	9.93	15.82
Milk Price Realized	16-18	10-12	14-18	16-18

Table 6. Farming Systems: Factors Contributing to Economic Viability (Tk. per farm per year)

Contributory Factor	Mymensingh	Khulna-Satkhira	Sirajgonj-Bera	Chittagong
Calf Mortality	899	1,050	1,351	1,201
Age at First Calving	14,181	13,647	22,666	9,002
Calving Interval	481	481	534	534
Lactation Length	2,726	9,425	21,419	6,189
Milk Production	29,203	35,038	61,318	43,802
Total Economic Opportunity	47,490	59,641	107,288	60,728

1 US$ = 58 Tk (approx.)

Veterinary Health Care

Bangladesh has a good veterinary network across the country. All districts have veterinary clinics with extensions to Upazilla (Sub district) level. These veterinary hospitals are equipped with some diagnostic facilities. DLS has a network of seven Field Disease Investigation and a Central Disease Investigation Laboratory. Vaccination is another important tool for disease control and Government owned The Livestock Research Institute produces majority of cattle vaccines.

Breeding Policy

In 1982, cattle breeding policy was adopted to improve the genetic quality of cattle for high milk production. The main objective was to attain self-sufficiency in milk production with some emphasis on meat production and increase the efficiency of draught power. The operational procedure of cattle breeding policy was: genetic up-gradation of local non-descriptive zebus by crossing with taurus cattle of European origin. The country is classified as intensive and extensive operational zones. The urban, peri-urban and milk pocket areas of the country are considered intensive zone. In this zone, the local cattle were to be bred with pure Holstein Frisian bulls. The extensive zone included the rural Bangladesh. The policy recommended crossbreeding the cattle with 50% crosses of Holstein Friesian. To conserve Sahiwal breed it was decided that good quality Sahiwal bulls would be used to improve the breed. The commercial farms and private entrepreneurs were given freedom to use Taurus bull semen in their farms.

Department of Livestock Services (DLS) has an extensive artificial insemination network comprising 22 District AI centers, 433 Upazilla AI sub-centers and 641 unions AI points using liquid and frozen semen. The Central Cattle Breeding Station and AI Laboratory, Savar, Dhaka is working as the core center for production of frozen semen and liquid semen. The Government has initiated Embryo Transfer project to expand the AI activities. It is planned that about 1,000 artificial insemination service center will be established by 2006. The artificial insemination activities of last 5 years have increased substantially from 0.934 million in 1999-2000 to 1.319 million doses in 2003-2004 (Figure 1). To support selective breeding activities envisaged in the breeding policy, government has undertaken a project “Breed Up Gradation through Progeny Testing” with the core objectives to produce “Proven Bull” across the country to be used in the national AI program.

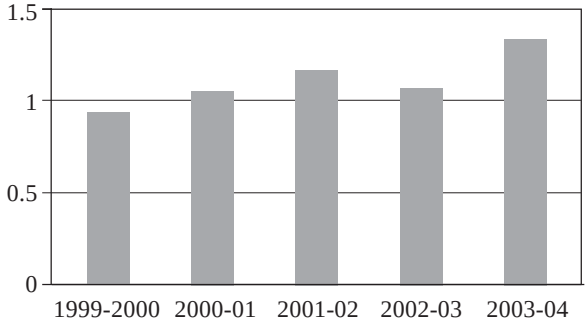

Figure 1. Artificial Insemination Trend: 1999-2004

PROBLEMS OF DAIRY FARMING IN BANGLADESH

The reasons for low productivity of cattle in Bangladesh were identified, among others, as: feed shortage, widespread infectious and production diseases and inefficiencies leading to low productivity; prolonged calving interval and low conception rate. These were a result of inefficient management of nutrition, estrus and AI services (Shamsuddin et al., 2001). Research conducted to identify the problems of farmers revealed four main reasons, they were: inadequate infrastructure and facilities for milk marketing; high cost of production of milk; low reproductive capacity of animals and the loss of production due to diseases.

Milk is highly perishable. The milk processing facilities is still very inadequate. Producers rely on selling raw milk and they cannot realize good and predictable price for their milk. Farmers in rural areas/remote areas from cities or town get minimum milk price. Milk price near the periurban areas is much lower to the producers and the middlemen take the maximum share of the price realized from the consumer. In Dhaka and other big cities, the price per liter is always Tk 20.00 or more. There is a need to establish facilities for milk purchase, chilling center as well as milk processing plant.

A participatory rural appraisal exercise demonstrated (Table 7) that requirements of farmers were for: on-farm services to troubleshoot feeding, health and reproduction related problems and to help increase their income. Farmers prioritized that training be given to them in management of profitable farms, and to the inseminators and veterinarians to enable them to deliver effective services (Shamsuddin et al., 2004). There is, thus, a need to reorient the traditional hospital based emergency veterinary service on farm service. The benefits demonstrated by herd health services in developed dairy industries cannot be implemented in because dairy farms in Bangladesh comprise of very few cows. In Bangladesh, like in India, smallholder dairy farmers' cooperative were successful in developing milk market and inputs delivery (Shamsuddin et al., 2002).

Table 7. Priority Requirement of Farmers

Mymensingh	Shahjadpur-Bera	Khulna-Shatkhira	Chittagong
Inadequate training (40)	Low land (22)	Inadequate training (24)	Social instability (34)
Inadequate supply of farm input (19)	Less number of veterinarians (12)	Underdeveloped communication system (23)	Scarcity of capital(31)
Social instability (13)	Limited milk procuring capacity of milk vita (12)	Less number of veterinarians (21)	Inadequate training (29)
Less number of veterinarians (13)		Scarcity of capital (16)	Scarcity of fodder land (14)
Adverse climate (12)		Scarcity of fodder land (15)	Less number of veterinarians (10)
Absence of Power Supply (5)		Less accountability of Administration (9)	Scarcity of cross bred cows (6)
Long distance of AI center		Absence of support from neighbors (7)	Scarcity of quality semen (5)
		Prevalence of mastitis (5)	Scarcity of advanced technology (5)
			Problem of milk sale (4)
			Distance of veterinary hospitals (2)

PROSPECTS FOR DAIRY DEVELOPMENT IN BANGLADESH

The government is keen to increase the per capita daily availability of milk from the current level of 41.2 ml per day to the prescribed nutritional requirement of 250 ml per day. So as to meet with the prescribed demand of milk of the increasing population, milk production in Bangladesh needs to grow by 4.2-5.6% per annum by 2010. This growth would create opportunities for smallholder producers and generate technical job opportunities in milk processing and marketing. To achieve the optimum growth rate in the dairy industry of Bangladesh, several factors need to be addressed. These include the poor genetic base of cattle, feed shortage, wide spread infectious and production diseases and inefficiencies leading to low productivity. Farm owners have largely overlooked the economics of interventions in these factors. Assessment of the herds' status and identification of the general areas of management where intervention is possible is of utmost importance for profitable dairy farms.

Government Policy for Dairy Development

In 1992, government adopted a Livestock Policy. The first objective of that policy, among others, was to attain self-sufficiency in milk production, with emphasis on import substitution of dried milk. The specific directives for dairy development were:

1. Financial and technical support to increase milk production;
2. Support establishing commercial farms;
3. Consider dairy and dairy product related trade and industry as priority area;
4. Providing better service delivery to milk shed area;
5. Reducing dependence on dried milk import; and
6. Proper application of Breeding Policy.

Infrastructure Support

Since dairy is a recognized tool for poverty reduction; the government is keen to develop dairy. Rapid urbanization and steady income growth are factors that incite demand for milk and milk products. The government has taken several initiatives, e.g., increasing milk production through breed improvement; increasing feed and fodder cultivation, improving facilities for heath care of animals; training of farmers and government and non-government personnel in various areas of animal management, and giving incentives to farmers for dairy development. Considering the importance of nutrient supply, government has given utmost priority to fodder cultivation. Livestock Research Institute and Bangladesh Agricultural University conduct research for developing an alternate and cheap feed to support dairy development. They also give emphasis on adaptation of existing technologies around the world in our country. All the 460 upazila livestock offices have demonstration fodder nurseries. The dairy farms of government along with breed development program support peoples by supplying seedlings. On the other hand, the extension network of DLS motivates and advises people for improved variety fodder cultivation.

Training and Development

Small-scale dairy farmers suffer from lack of knowledge and limited access to technologies and services. Considering the weakness of farmers DLS and other GO and NGOs undertake training program for the small-scale dairy farmers. With the technical assistance of FAO a Dairy Demonstration and Training Center will be established at Central Cattle Breeding Station, Savar, Dhaka.

Incentives to farmers

Considering the importance of small-scale dairying for employment generation, government has introduced incentives for them. Under the program, 50 million Taka has been distributed to 4,000 small-scale farmers all over the country those have 1-5 cows. The incentive introduced earlier in 1993-95 had a positive impact to small-scale dairy.

ACKNOWLEDGEMENT

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2. FIJI

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INTRODUCTION

Fiji consists of more than 800 islands and islets of which about 100 are inhabited. The islands cover a total area of 18,376 sq km. The two largest islands Viti Levu and Vanau Levu comprise more than 85 percent of the total area. Fiji has a total population of 880,874 with a density of 48 per sq km. Half the population live in rural areas and shifting to urban areas. Suva, the capital of Fiji has 20 percent of the total population. The population shift is associated with increased poverty and crime.The climate of Fiji is tropical with average temperature of 25^{o} C and average rainfall of 3,300-mm. Fiji's native plants include hardwood trees, mangroves, bamboo and coconut palms. The only native animals of Fiji are rats and bats, but settlers brought cattle, dogs, goats, horses and sheep.

Forests cover about 45 percent of the land area in the islands. Annual loss of forests is estimated at 0.21 percent.

In 2002, agriculture, including forestry and fishery, contributed 16 percent to the national gross domestic product (GDP) and employed 2 percent of the Fiji's workforce. Industry, including mining, manufacturing and construction contributed 27 percent to the GDP and employed 34 percent of the workforce. Major earnings in foreign exchange are from tourism and sugar.

Sugarcane is the principal cash crop and rice is a subsistence crop. Vegetable, fruits, beef, pork, poultry and dairy products are produced for the local market. Fishing is a subsistence activity but commercial fishing is now increasing. Gold and silver are principal minerals.

This paper was prepared to provide an insight into the current status of the Fiji dairy industry; highlight the wide disparity between domestic production and imports and to seek the endorsement of the cabinet of Fiji for the proposed five-year, 2005-09, revitalization and decentralization plan for the dairy industry.

CURRENT STATUS OF THE DAIRY INDUSTRY

According to the FAO (2000) Fiji's annual domestic demand for milk is estimated at 80 million liters. The domestic production of milk has been static for the last five years at 10 million liters per annum. There are 227 registered dairy farmers in Fiji. Of these 206 are milk suppliers to Rewa Co-operative Dairy Company Limited (RCDCL), and 35 supply fresh milk, cream and ghee directly to the consumers.

Approximately 80 percent of the registered dairy farmers are smallholder producer. Their production accounts for 44 percent of all fresh milk supplied to the RCDCL. The average production per cow in Fiji is about 4 liters per day. The peak daily yield is between 8-10 liters per cow. This compares poorly to 30 liters per cow per day in Israel and 20 liters in Australia and New Zealand.

A review of annual milk production trends showed that between 1979 and 1998 milk production had increased at 4 percent per annum but there was a continuing decline by 5.6 percent per annum from 1999 to 2001. The decline can be attributed to the political unrest in 2000 that caused fears amongst most of the large farmers in the Tailevu/ Korovou area. The drought of 1998 could be responsible for the decline 1999.

The development programs were implemented over a medium to long term in the past to improve efficiency in dairy production. The objective was to increase quantity and quality of milk production and to gradually reduce imports and possibly export local dairy products to the neighboring countries in the pacific region. But the results have not been very encouraging. There was little or no improve-

ment in production and efficiency. A survey report has shown that the cane belt areas in the West and North and the Central division with village settlements have a potential to rear more than 10,000 cows at subsistence level. They can produce substantial milk.

DEPENDENCE ON IMPORTS

The RCDCL has the capacity to process 40 million liters annually. Records maintained by the RCDCL show that highest milk production in Fiji was in 1998 when it touched 12,456,712 liters of fresh milk, the highest production on record so far. This is as against an estimated annual consumption of 80 million liters. Therefore, on an average, Fiji has to depend on imported milk powder. According to the national statistics highest import of milk powder on record was 5,041 tons of total milk fat equivalent (TMFE) in 1995. This represented 80 percent of total demand for the country.

From 1990 to 1995, milk import increased at the rate of 33.5 percent per annum and declined steadily from 1995 to 1998. Thereafter, milk import again increased at 7 percent per annum from 1999 to 2000. It is forecasted that the import will continue to increase because demand would continue to increase while the domestic milk production is static.

FUTURE OF THE FIJI DAIRY INDUSTRY

As the industry leader the RCDCL has projected that it would process over 20 million liters of milk in 2008 and 26 million liters in 2009. If the entire increase for the processed milk has to come from domestic production, additional 10,000 milking cows should produce an average of 7.7 liters per day. It is projected that domestic milk production can be increased by facilitating the large farmers, constituting 20 percent of milk production, to increase their production from the current 8.0 million liters gradually to 14 million liters by 2009. In addition, 177 small producers and 30 new dairy farms to be set up in Tailevu South, Rewa, Wainibuka and Serua should produce 12 million liters by 2009.

CHALLENGES AND OPPORTUNITIES

A major challenge to all stakeholders, the government, the RCDCL and the private sector is to reduce import of milk and milk products by 20 percent over next five years. It is possible to increase the domestic milk production by diversification and expansion to Western and Northern division Vitu Levu. There is a potential of producing 4 million liters of milk from the cane belt areas.

Since the productivity of Fiji cattle is low, there is need to increase cow productivity, farmer productivity and land productivity through integrated measures. Productivity of cows can be improved through breed improvement and upgrading the dairy herds. The smallholder farmers need to be encouraged to adopt intensive dairy concepts for milk production. The productivity of land should be improved through better drainage, proper utilization of land resources, development of pastures and controlled movement of cattle on the pastures to ensure their best productivity and maintain high production of milk. Farmers should improve the calf sheds, stockyard and night paddocks for keeping their cattle.

There is a need for imparting training to the staff. The staff in turn should give formal and non-formal training in production to the milk producers.

There is need for construction and upgrading the market access road infrastructure. Linkage of the rural areas to urban market centers would improve the farmers' productivity. Also several mini fresh milk collecting centers should be established so as to help the farmers sell their milk.

REVITALIZATION AND DECENTRALIZATION PROPOSAL

With an aim to alleviate poverty, build food security, generate rural employment and accelerate economic productivity a project for revitalization and decentralization of the dairy industry has been proposed to the government. Highlights of the proposal are given below:

Vision: A dynamic dairy industry that will redefine the standard of rural living and drives the national economy by providing for healthy food security, export opportunities and permanent employment.

Mission: To provide high quality customer driven services that will enhance the development of all sectors of the Dairy Industry through healthy farm production to consumers.

Target: It is projected, that by the end of the project period, overall milk production from the farms would have increased from benchmark level of 10 million liters to 26 million liters in the final year. With the projected production performance, annual average gross earning of each farm should increase to F$40,000.

Beneficiaries: The beneficiaries of the revitalization and decentralization program would be the smallholder farmers, new farmers and large farmers (bulk suppliers to RCDCL). In total, 143 rural-based farmers have been identified. These farmers will be assisted to improve their yearly milk production by 30-50 percent over the five-year project period. The geographic spread of these rural-based dairy farmers would comprise: 72 in Tailevu province, and 105 in Naitasiri province. In addition 40 new farmers have been identified: 10 in Rewa delta, 10 at Navue flat, 10 in Tailevu South and 10 in Wainibuka region. The annual production target for the new promising farmers would be 600,000 liters in the first year, which would increase by 5 percent per annum every year to 2009. In the Western division the program would be started in 2006. Large farmers who have been bulk suppliers to RCDCL have been targeted under this revitalization program to produce 12 million liters of milk annually. Major players in these categories include Viti corps, Navuso Agiculture School Farm, Rewa Dairy bulk producers and the Koronivia Research Station Dairy Unit.

Majority of the 177 low producers are ethnic Fijians, operating under many constraints that limits production and makes them vulnerable. While the small landholders suffer from low productivity, most of the large landholders are threatened because lease of land cultivated by them is likely to expire between 2010 and 2012. These facts would be brought to the notice of the government and appropriate solutions sought.

The program has a built-in flexibility in its approach to shift from the traditional production-driven approach to productivity-driven approach. The smallholders would be trained to adopt practices for intensive, semi-commercial dairy farms to increase their productivity. The program would promote farming as a rewarding profession by giving training and education in agriculture and dairy production and productivity to young farmers. The program would encourage the use of appropriate innovative technology to facilitate production and marketing of good quality milk and value-added products. It is expected that it will improve smallholders' performance from 5 liters in 2004 to 8 liters per cow per day in 2007; and would increase revenue from milk from F$7.1 million in 2004 to F$13 million in 2008.

The project would help to increase milk intake of RCDCL from the 10.9 liters in 2002 to over 26 million liters in 2007. The project would assist the RCDCL bulk suppliers (20 percent) through technical and advisory service, infrastructure development and maintenance of market access roads. The revival of Viti Corp Ltd and Navuso Agricultural School Dairy farms as bulk suppliers would increase the intake of the RCDCL.

The Program Stakeholders: It is expected that the government of Fiji would ensure strict compliance of the regulations to maintain the standards of quality prescribed under the International Agreement and Statutory Regulations. The FAO assistance would be provided to smallholder dairy farmers that have been identified in Viti Levu central and western divisions and in Ovalau.

The Program Activities: The revitalization program has been grouped into eight time bound sub programs to ensure smooth implementation. The focus would be on: Nutrition Improvement; Genetic Improvement; Infrastructure Development; Improvement of Animal Health; Improvement of Calf Rearing Management; Increase Land Productivity; Increase Human Resource Productivity; Revitalizing Viti Corps Ltd And Navuso Agriculture School Dairy Farm; and Establishment Of A Dairy Industry Council.

Budget: It is expected that the dairy revitalization program would require F$7,695,450 (1 US$ = 2.2 F$) over a five-year period 2005-2009.

3. INDIA

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INTRODUCTION

During the 1950s and 1960s, India was primarily an import dependent country importing about 43 percent of milk solids in the total throughput of dairy industry and the commercial import of milk powder touched its peak in 1963-64. This had policy makers concerned and contributed to build a viable and self-sustaining national dairy sector. A decision was then taken to achieve self-sufficiency in milk production and "Operation Flood" program, one of the World's largest and most successful dairy development programs, was launched in 1970, with the National Dairy Development Board (NDDB) as the apex agency. Then in 1989 "Technology Mission on Dairy Development" was launched to support and supplement the efforts of Operation Flood program and to enhance rural employment opportunities and income generation through dairying. These programs resulted in a spectacular growth of milk production in the country. During the last two-and-a-half decades since the launch of Operation Flood, the milk production in the country has increased from about 22 million tons in 1970-71 to 88.1 million tons in 2003-04. India has emerged as the world leader in milk production surpassing the USA. India's milk production grew at about 4 percent per annum, which has far exceeded the global average of about 1 percent. The per capita availability of milk that had been decreasing before the implementation of the Operation Flood program was not only held but it also increased from 107 g in 1970 to 232 g in 2003-04. Still, the per capita consumption of milk in India is one of the lowest in the world. Consumption of milk in India has grown faster than food grains. As calculated form the data provided by the Economic Survey 2004-05 (Table 1.18, 1.21 and 9.7) food grains per capita availability was 145 kg in 1951; 172 kg in 1961and 1971; 167 kg in 1981; 187 kg in 1991; and 152 kg in 2001. In comparison the per capita availability of milk was 47 kg in 1951; 45 kg in 1961; 40 kg in 1971; 50 kg in 1981; 63 kg in 1991; and 78 kg in 2001 (Table 1).

Table 1. Availability of Food Grains and Milk in India From 1951 to 2001

	Unit	1951	1961	1971	1981	1991	2001
Population	Million	361,088	439,235	548,160	683,329	846,421	1,028,737
Food Grains	Million Tons	52.4	75.7	94.3	101.4	144.8	157.0
Milk	Million Tons	17.0	20.0	22.0	31.6	53.9	80.6
Food Grains	Kg/cap	145	172	172	167	187	152
Milk	Kg/cap	47	45	40	50	63	78

Reference: Table 1.18; 1.21 and 9.7 of the Economic Survey 2004-05

IMPORTANCE OF DAIRY INDUSTRY TO THE INDIAN ECONOMY

Contribution to National Economy: Contribution of agriculture, during the last few decades, to the national Gross Domestic Product (GDP) has decreased and that of livestock sector increased from 4.8 percent in 1980-81 to about 6.5 percent in 2002-03. Growth in agriculture has been generally erratic and dependent on the performance of monsoons. On the other hand the dairy sector has been withstanding the vagaries of weather and has sustained a growth of around 4.5 percent per annum. It is estimated that during 2002-03 the gross value of output from livestock sector, at current prices, was

* Dr. Rattan Sagar Khanna, a resource person as well as the editor of this publication, prepared and submitted the country paper on "Indian Dairy Sector" in place of the selected participant from India who could not attend the seminar due to visa problem.

INR 1,560.8 billion (1 US$= IR 43.5) of which milk and milk products was INR 1,070 billion (Economic Survey 2004-05). The contribution of milk and milk products to the total livestock sector has increased from 49 percent in 1950-51 to over 67 percent in 2002-03.

Smallholder Dairy and Poverty Alleviation: Livestock is the sole or partial source of livelihood for nearly 200 million rural poor. More important, the distribution of livestock has been found to be more equitable than that of land, leading to a more equitable distribution of gains from livestock production. The bottom 60 percent of rural households own 65 percent of all milch animals. A large proportion of livestock owning households comprised of small and marginal farmers and landless laborers. Since the demand for livestock products is expected to expand, dairy sector offers an opportunity for poverty reduction. Dependence of the rural poor on agriculture is undergoing major change. Census 2000 indicated that workforce associated with crop production has fallen from 74 percent in 1961 to 54 percent in 2000 (Alagh, 2002). The population engaged in management of animals and milk production increased from 2 percent in 1961 to 4.1 percent in 2000. This shift indicated that agriculture is becoming more consolidated, less labor intensive and mechanized while dairy has fortified the development and growth of the rural farm and non-farm sector and rural employment.

It is a matter to notice that the share of animal husbandry and dairying in total plan outlay has been consistently declining from about 1.5 percent in the fourth plan to about 0.25 percent in the ninth plan. Despite this fact the dairy has been consistently growing at more than 4 percent per annum. This is attributed to the small and marginal farmers in India that they have sustained milk production at minimal cost to the national exchequer.

Table 2. Indian Dairying at a Glance (2002-03)

Performance Indicator	Unit	
Human Population[1]	1,049 million (70 million dairy farmers)	
Milk Production[1]	88 million tons (240 million liters per day)	
Average Annual Growth Rate[1]	4.0-4.5 percent	
Per capita Availability[1]	232 g per day / 84 kg per annum	
Dairy Animals in '000 (2003 census)[2]:	Number	Percent growth over 1997
Crossbred Cattle	22,073	9.82
Indigenous Cattle	156,865	-12.26
Buffaloes	93,225	3.68
Goat	114,594	-6.62
Sheep	61,507	6.98
Cattle Feed Production[3]	1.5 million tons	
Dairy Plants Throughput[3]	26 million liters per day	
Milk Consumption (Percent)[3]:		
Rural : Urban	45:55	
Liquid Milk : Milk Products	46:54	

Sources: [1] Economic Survey 2004-05; [2] Narang (2004); [3] Aneja and Gupta (2004)

BUFFALO – THE MAINSTAY OF DAIRY INDUSTRY

Buffalo, undoubtedly, plays the most important role in the development and growth of the Indian dairy sector. With 53 percent of the world buffalo population, India produces 63 percent of the world buffalo milk production. According to the FAO 2002 statistics, amongst the agricultural commodities contributing to the national economy, buffalo milk come second after paddy. Of the 88 million tons of milk, 56 percent was from buffaloes while they constituted 34 percent of the total population of 272 million cattle and buffaloes (Table 2).

That the Indian dairy farmer attaches significance to buffalo as the dairy animal can be appreciated from the fact that the number of buffaloes have grown by 42 percent from 66 million in 1981 to 93.23 million in 2003 (FAO 1981, 2000 and Narang 2004). Describing the evolution of buffaloes in India, Pathak (2003) has attested that "it was the deep involvement of people of this region in the

buffaloes due to which it could be possible to evolve several breeds of buffaloes capable of thriving and performing in the prevalent agro-climatic conditions and herbage crops". According to him there are two main types of buffaloes in India: the Murrah group comprising: Murrah Mehsana, Nili Ravi, Kundi and Jaffarabadi that are characterized by a massive body, black color, high milk yield and absence of chevron and the second group is lighter in body size, skin and coat color.

Buffalo is a very resilient animal. It can adapt to a wide range of agro-climatic conditions, can survive on agriculture by-products and coarse roughage for its diet, has adequate resistance to prevalent diseases, does not require intensive management care and expensive housing,

Buffalo milk is very rich in fat and non-fat content; the meat is balanced in amino acid composition. As compared to cow, buffalo milk is considered superior (Kurien, 2003) because of lower cholesterol content, high protein efficiency ratio, higher content of calcium, iron, phosphorus, vitamin A, is whiter and has better whitening property, is good for specialty products like mozzarella cheese, has higher levels of bio-protective factors like lactoferrin, lysozyme, lactoperoxidase, and bifidogenic factors, milk proteins are more resistant to heat denaturation.

Of the total population 75-80 percent buffaloes in India are nondescript. India has the best milch breeds of buffaloes namely: Murrah, Nili Ravi, Surti, and Jaffrabadi that originated in Northwestern India. Because of their high potential for production of higher quantity and better quality of milk they are now preferred all over India for breeding and up gradation of other regional breeds of buffaloes. Acharya and Bhat (1988) have classified Indian buffaloes into five groups based on their habitat, breeding tract. Ahlawat et.al. (2003) have given detailed characteristics of various breeds. While the process of interbreeding is helping in up gradation of the non descript buffaloes, the number of purebreds is reducing at an alarming rate. Important breeds of buffaloes are: in Uttar Pradesh: Bhadawari and Tarai; in Maharashtra: Nagpuri and Pandharpuri; in Orissa and Andhra Pradesh: Jerali, Kalahandi, Kujang, Manda, Parlakhemundi, and Sambalpuri; in Tamil Nadu, Karnataka and Kerala: Toda and South Canara. Through sustained breeding with Murrah, Mehsana breed has been evolved from Surti in Gujarat and Godavari from nondescript buffaloes in Andhra Pradesh.

OPERATION FLOOD AND EVOLUTION OF DAIRY IN INDIA

Anand pattern of dairy co-operatives, tested for 25 years before launch of 'Operation Flood' program formed its basis. It started with formation of two co-operative societies at village level and a union at Anand as the Kaira District Co-operative Milk Producers' Union. The core feature of this model is the farmer control through the value chain of milk procurement, processing and marketing. Each function is performed by an independent legal organization. Milk production and procurement is carried out by the primary level village level co-operative societies. The secondary level district co-operative milk producers' union carries out milk processing and product manufacture. The state level dairy federation carries out the marketing function.

Operation Flood Program was implemented in three phases. Operation Flood-I sought to create 18 "Anands" with an investment of INR 1,160 million. These funds were generated from the dairy commodities – skim milk powder, white butter and butter oil received from the World Food Program. The concept was not to distribute the dairy commodities free of cost. But to convert these into liquid milk and sell milk at the normal market rate prevalent at that time. Free distribution of commodities affects the market prices badly. Operation Flood sought to avoid this weakness. The funds generated were invested in building national infrastructure for milk procurement, processing and distribution.

The initiation of Operation Flood-I led to a resurgence in the dairy industry during the seventies and a much larger dairy development program was initiated as Operation Flood-II in October, 1979, funded by a soft loan of US$150 million from the World Bank in addition to the money generated from the dairy commodities gifted by the European Community and the internal resources of the erstwhile Indian Diary Corporation.

The results achieved in Operation Flood-II justified the confidence placed by the government in the farmers' own organizations as the instruments for dairy development. This lead to the implementation of Operation Flood-III, funded by a soft loan of US$365 million from the World Bank. The gift of commodities from the European Community continued. Funds were also available from the internal resources of the Indian Dairy Corporation.

The funds were given to the state level dairy co-operative federations for creation of rural and urban infrastructure for dairy development. Generally 50 percent of the funds were given as non-refundable grant and another 50 percent was given as loan repayable over a period of fifteen years. The repayment of loans received by the Indian Dairy Corporation/ National Dairy Development Board formed a corpus that continued to be invested in co-operative dairy sector even after the financing from the World Bank came to an end and the European Community suspended the gift of commodities.

Reviewing the progress of Operation Flood during 1993-94 the NDDB observed "the total throughput of the dairy industry in India has been rising steadily since 1974-75. Indigenous milk production has shown a similar trend. Commercial imports of dairy products ceased in 1976; the imports since then have been gifts, accounting for less than 1 percent of India's milk production. Imports of milk powder did not rise with increase in throughput despite repeated spells of severe droughts and floods. In addition all the dairy products now available in India are of Indian manufacture, without the use of any imported milk powder".

The success of Operation Flood can be appreciated from the progress made in milk production, procurement and marketing. Average milk procurement increased from 2.56 million lpd during Operation Flood-I to 11 million liters per day (lpd) during Operation Flood-III. Average liquid milk marketing increased from 2.8 million lpd during Operation Flood-I to 15 million lpd during Operation Flood-III. During 2004 the dairy co-operative network in India comprised 11 million farmers as members of 100,000 Village Dairy Co-operatives federated into 180 District Milk Producers' Unions and 18 apex level State Co-operative Dairy Federations.

DAIRY CO-OPERATIVES IN INDIA

25th Annual Rept of the GCMMF: "Co-operatives are grounded in the values of self-help, self-responsibility, democracy, equality, equity and solidarity. We believe in our Principles - not because they are there, in our byelaws, but, because, they are ingrained in our spirit. The unique structure, that we have created, is largely a result of the first principle – that of **Voluntary and Open Membership.** Co-operatives do not discriminate on the basis of gender, or on the basis of social, political and religious beliefs. **Democratic Member Control** provides for decentralized decision-making reflected in policies by and for the member. The men and women who serve as the elected representatives are accountable to the membership. The basic capital of the co-operative is **Member Economic Participation.** Equitable distribution of surplus by investing in the co-operative, contributing to reserve and benefiting the members in their way of life, are all a healthy sign of the functioning of a co-operative. **Autonomy and Independence** is essential to the co-operative remaining faithful to its values and principles. We strengthen these values and principles by investing in **Education, Training and Information,** enriching our members' and the general public's understanding of the principles of co-operation. **Co-operating among co-operatives** is reflected in everything that we do - whether as GCMMF, its constituent unions or the co-operatives that own us. Each of us must continually seek opportunities for local, national, regional, and international co-operation. Last but not the least, is **Concern for Community.** For what use is the co-operation if there is no common good for the community." As the founder of dairy co-operatives AMUL had continued to strengthen its structure and grew from strength to strength. But all has not been well with amny other dairy co-operatives.

Reformation of Dairy Co-operatives: In its final evaluation report of Operation Flood, the World Bank (Wilfred and Kumar, 1998), concluded that the principles of Anand pattern for full farmer control have been facing a continuing problem of "rejection by the politicians and bureaucrats… politicians continue to harass the co-operative system… issues of governmental interventions, cost control and subsidies are intertwined" lead to "mixed ownership and control" of co-operatives which has a "subtle and corrosive effect of government intervention" on the co-operatives. The problem has been diagnosed to the fact that the government still owns the physical infrastructure and has guaranteed the repayment of loans. The net result of this intervention is that it reduces the efficiency, increases the costs and "undermines the value of the state's assets" and the symptom this conflict according to the study is "continued appointment of *civil servants* as managing directors".

The government draws the powers for interfering in the functioning of co-operatives through the State Co-operative Act, rules and regulations. There is nothing new in the information that is being

furnished. Way back in 1991 the Brahm Prakash Committee had enlightened that "the essence of co-operative organization is the principle of democratic management, signifying institutional regulation by members and their elected representatives in accordance with the bye-laws, It precludes control and interference by any agency including Government…" The Committee had identified the following restrictive provision in the State Co-operative Societies Act that empowered the Government/Registrar to:

- Notify compulsory amendment of bye-laws
- Nominate directors on the Management Committee/Board of Directors
- Veto, annul, rescind resolutions of the Board/General Body
- Give any directives
- Supersede/suspend the Management Committee/Board of Directors
- Restrict the terms of office of office bearers
- Compulsorily amalgamate/divide the co-operative societies

Clearly all the problems that hamper the efficient functioning of the dairy co-operatives emerge from one common factor – the Government support. The support can be in the form of financial and/or management. It is a matter of perception as to how this support helps.

Let us take the case of financial assistance. If any person, leave alone the government, gives an assurance to the chief executive that the losses incurred by the business enterprise, he is heading, would be made up, notwithstanding the reasons of loss, the chief executive would have no reason to manage that enterprise efficiently and according to strict business ethics and principles. On the other hand when the government assures that the loss of the enterprise would be made from state resources, it gains legitimate right to give directives for unsuccessful working of the enterprise. Either way a foundation has been laid for inefficiency. There would a conflict when under such conditions the expectation is that the enterprise should make profit or at least pay for its own managerial expenses. By then is too late.

The other is the management intervention. The assistance is generally in the form of appointment of chief executive from the civil services. There is a merit to it. Experience of managing large organizations as a generalist has its advantages. It is possible to highlight many cases of success in business enterprises. The conflict arises when compared to others the dairy enterprise is considered backward or of secondary importance in the state. Appointments are for indeterminately brief periods. Priorities of the government in personnel placement invariably supersede the business needs of the Federation. From frequent changes the organization invariably suffers from continuous discontinuity of the chief executive. There is consequent breach in the policy statement, implementation of policy, style of functioning, reporting and communication. In fact the entire organizational behavior undergoes changes so often that it suffers from severe schizophrenia. Such a discontinuation in top management negates an expression of the Dairy Co-operative being a business organization.

Strength in marketing has helped the co-operatives to realize a better price for milk produced by the farmers. Anand pattern also showed that success of marketing was a function of the 'brand'. Gujarat Co-operative Milk Marketing Federation and its affiliated unions have jointly developed and built nationally and internationally known 'AMUL' and 'Sagar' brands. Apart from AMUL other state co-operatives have build their own brands – Vijaya, Verka, Milma. Aavin, Nandini, Saras, Parag and Vita are to name a few. They have withstood the competition with other national and multinational brands. The key to success of co-operatives, as demonstrated by the Gujarat Co-operative Milk Marketing Federation is "that co-operatives assisted by competent professional managers can attain levels of achievement far surpassing that of many an established enterprise in the Indian corporate sector. The competence displayed by the Federation should demolish all too frequent criticism of co-operatives that their divided and shared management prevents the attainment of the highest achievements in production and marketing (Kurien, 1983). Management intervention by the NDDB has proven that reviving a sick dairy co-operative is not an impossible task. They have brought the dairy co-operatives in Punjab, Rajasthan, Bihar, and Karnataka out of near moribund condition and made them commercially sound and financially viable business enterprises. The success in reviving was achieved while maintaining the democratic co-operative structure and providing management help at senior levels that helped by: strengthening the rural procurement network; right product mix; financial and commercial discipline; continuity in professional management; and human resource development and management.

PRIVATE DAIRY SECTOR IN INDIA

"Very regulated and inward looking" is the identification given by Chris Phillip to the Australian dairy industry of the 1980s, very akin to the Indian dairy sector of the 1990s. It was receiving price support from the government, all the companies operated as a pool and common wholesale prices, avoiding competition and involved a large number of small producers. The business was limited to domestic sector with no international marketing strategy. Since exports to EU countries were through accession negotiation, and since Australia was perceived as a subsidized dairy industry the export contracts shifted to New Zealand. The change started after 1980, when the Australian Federal government linked domestic dairy prices to the international prices and reduced domestic price subsidy from around 40 percent to 20 percent. As a result in the next 10-15 years, the Australian milk production declined by 30 percent; dairy herd size reduced by 35 percent; number of dairy farms declined by 50 percent; and the export volume declined by 40 percent. The structural changes announced by the government shook the industry to become independent, market savvy, and internationally competitive. Results were dramatic. From 1990s Australian milk production rose from 6.5 billion liters to 10 billion liters; of the total production more than 50 percent products were exported; and the industry became vibrant and internationally competitive.

Domestic changes occurring in the Indian dairy sector have been similar. As a consequence of the liberalization, there was less governmental intervention and regulations. The negative implication was that fall in international prices of dairy commodities particularly bulk milk powder, butter and butter oil increased their import and the small industrial units suffered the most.

Until June 1991, the dairy industry was under strict regimentation of the industries act. This had apprehended the private entrepreneur to invest in this sector. Untrue, but surprisingly it was generally perceived that the dairy industry was reserved for the co-operative and not for the private enterprise. The Government of India delicenced the dairy sector in June 1991 and the private sector companies including multi-nationals were allowed to set up milk processing and manufacturing plants. The basic philosophy underlying delicensing was to encourage the competition in procurement and marketing of milk, thus increasing value for both producers and consumers. The liberalization of the dairy sector during 1992 saw a boom in investment by the private sector and many dairy plants were set up. The dairy organizations in the government, public and the co-operative received lesser finances compared to the previous decades of "Operation Flood Programme" for investment in infrastructure, and rural networking for working capital and for 'meeting losses'. Multinationals made investments very skeptically. There was phenomenal increase in production and availability of raw milk. The consumer market for processed milk and milk products continued to expand. The dairy plants established prior to liberalization continued to prosper and perform well.

But most of those set up after the liberalization either languished or perished. During 1994, the author of this paper had a chance meeting with the chairman/owner of a company based in Punjab having two dairy plants, one each in Punjab and Uttar Pradesh bordering Delhi (Khanna 2004b). Doing brisk business in milk powders and ghee the Chairman thought of setting up another dairy plant with a diverse portfolio of milk products. The chairman sought author's opinion, for the location and the product range. The author simply advised the chairman to wait for another two years and there would be many dairy plants up for sale. In 1998, the author helped the chairman sell his dairy plant in Uttar Pradesh. The prediction was simplistic; there were more plants than required in northern states of India. Most of the dairy plants and companies set up in the private sector during 1990's were like weather frogs that croaked while it rained. The dairies were not managed organizations but one man shows for making quick money. The plants were commissioned and run when raw milk was cheap and price of milk powder and ghee was high. If profit was assured, the owner hired staff and operated the plant otherwise the plant was ordered closed, staff sacked, and the unmanned plant was left to the mercy of a security guard till the price parity returned. The dairy plants were not an industry to be managed. Some dairy plants entered the export market. The milk powders and products produced by them were from milk that was not purchased directly from the producer. The quality was doubtful. The result was, as expected, the consignments of 'export' marked products did not cross Indian shores. If they did, the consigners were asked to take back. The dairy industry in India was passing through a serious crisis of management. There was a strong need for change management and learning how to undergo change.

Within a year of delicencing, over 100 new dairy processing plants came into being and most of which were designed to manufacture value-added products. The establishment of new dairy plants was skewed and there was a concentration in the northwestern India. The creation of capacities for manufacture of milk products was disproportionate to the availability of liquid milk. This caused a scramble for milk procurement. The shortage of marketable rural surplus of milk in comparison to the actual requirement, promoted the opportunists to synthesize a look alike of milk from vegetable oils, soap solution, urea, and other harmful ingredients and use the look alike as milk adulterant.

The dairy industry that had been built brick by brick over a period of more than two decades was threatened for existence by scourge of adulterated and contaminated milk produced and marketed by spurious milk producers. The industrial liberalization that was expected to unshackle the development and growth of this sector suddenly attacked the health and well being of the nation. The meaning of globalization should not be construed to be a grant for unwarranted and unbridled criticism, right or wrong, of any act, order or rule that is restrictive or regulatory in nature promulgated to protect the well being of the citizen.

It is to meet with these strict requirements that the Milk and Milk Products Order, 1992, was issued under section 3 of the Essential Commodities Act, 1955 by the Government of India. It was in the interest of the general public to regulate production and supply of liquid milk and milk products of desired quality. The industrial liberalization helped the development and growth of the dairy sector as can be seen from a large number of milk processing units registered under the Milk and Milk Products Order, 1992 (Table 3). It is noted that creation of handling capacity has been skewed in favor of the northern region particularly in the private sector. Of the all India 352 units, 262 dairy plants were registered in the northern region alone.

Table 3. Milk Plants Registered under MMPO, 1992

Region	Milk Prod. (LLPD)	Rural Milk Surplus (LLPD)	No. of Units registered in Coop /Gov't	Capacity (LLPD)	No. of Units in Pvt. Sector	Capacity (LLPD)	Total No. of Units	Total Capacity (LLPD)
North	369.31	164.08	67	73.60	262	221.71	329	295.31
East			17	7.32	1	1.20	18	8.52
West			91	158.76	49	47.01	140	205.77
South			62	100.41	40	27.93	102	128.34
Total			237	340.09	352	297.85	589	637.94

The Integrated Sample Surveys conducted by the state governments indicate that the average milk retention is almost 50 percent of milk production. Considering that production of milk in India averages 200 million liters per day, the processing capacity registered under the MMPO was almost 33 percent of milk production and 66 percent of the milk marketable surplus. In view of this fact the perception that the MMPO has created entry barrier for the private sector, especially in milk sheds where cooperatives have been in operation for many decades was misplaced. Another perception that cooperatives have been favored in granting registration was not confirmed by the data on registration. Some 390 private plants with a total processing capacity of 30.1 million liters per day were registered as against 212 cooperative dairies with a capacity of 28.4 million liters per day. It was also observed that 80 percent of the private sector dairies are localized in the four states of Hariana, Punjab, Uttar Pradesh and Maharashtra because these four states were the highest milk producing states in the country. It was observed that many registered private units did not build dairy plants and some of them were closed perhaps because of the rigors of competition for milk procurement.

CHALLENGES TO INDIAN DAIRYING

Impact of WTO agreements for international trade on the Indian dairy sector has been mixed. Konandreas (1999) noted that some of the commitments made had not been implemented, some of the expected impacts of AoA are yet to be felt, and some of the rules agreed to govern agricultural policy in the future may not be working. Sharma (2000) has observed that even in 2003, more than six years after

the agreements were signed, the global agricultural tariffs remain high, there is disparity in tariffs, developed countries continue to provide subsidy, provisions of the SPS and TBT agreements were misused to insulate the domestic market. In the US export subsidy in the year 2000 was estimated at US$3 billion. Against this 96 percent subsidy was on exports from the European Union and the United States (Chawla, 2000). According to Ingco the European Union had set its initial tariff bindings at unweighted average levels of 61 percent higher than actual tariff equivalents while the United States set its initial binding at 44 percent above actual levels. Consequently cuts applied would have had little impact, if at all.

Reviewing the impact of WTO-I, Vyas (1999) observed, "India had committed zero per cent base and bound rates on imports of skimmed and full cream milk powders and 40 percent on butterfat, cheese and whey under the WTO agreement. In contrast, the bound rate of duty for fresh milk and cream, buttermilk and yogurt was fixed at around 100-150 percent. No country other than Singapore has agreed to zero rate of duty." As of 1999/2000, the average tariff on agricultural products was about 14 percent for the US, 30 percent for the EU and 33 percent for Japan, compared to less than 5 percent for non-agricultural commodities. Among the US, the EU and Japan, some of the highest tariffs are for dairy products. The tariff rate for butter/butter oil was: Japan – 450 percent; the US – 134 to 144 percent; the EU – 144 to 147 percent; Canada – 298 percent; Poland – 102 percent; some of the developing countries: India – 40 percent; Pakistan – 100 percent; Bangladesh – 200 percent; Indonesia – 210 percent; South Africa – 79 percent. Similarly, for milk powders, the import duties in developed countries were much higher compared to India.

To protect the Indian dairy industry, Vyas (1999) recommended that India should renegotiate and raise its tariffs; levy 50-60 percent rates of duty on milk powders; seek provision of special safeguards for dairy products when international prices fall below 'trigger prices' and imports to India surged; ask for significant real reductions in subsidies on exports by the US and the EU; and insist on adoption of common standards on SPS measures. Shankar (2002) pointed out that as of February 2002, world market prices for milk products, especially butter, butter oil and skim milk powder, appear to have dropped to their lowest levels after the price falls in Europe and the US. The imports of butter oil into India have grown at an alarmingly fast rate of 7.7 percent per annum. It dampened the prices of ghee and butter in India and hurt the poor milk producer in India at the cost of the rich farmers of the US and the EU. In response, the Finance Minister increased the customs duty on butter and butter oil from 30 to 40 percent, in his budget for the fiscal 2002-03.

On introspection, it appears that the developed countries have been more vigilant on the impact that the WTO. They knew that developing countries could provide tough competition in the agricultural sector. Thus at the WTO II the issues that surfaced for discussions were very significant: need for substantial reduction in peak tariffs; facilitate greater market access to developing countries; an appropriate mechanism to check tariff escalation and under various tariff preference schemes, developing countries should be harmonized with the tariff reduction negotiations. Owing to anomalies in the implementation of tariff rate quotas, the market access provision of the AoA is greatly undermined, particularly in case of developing countries. These developments give an impression that preparations in India for the signing of the AoA in particular the dairy sector were very inadequate. The commitments made were based on the status when India was an import dependent country. Now that India had become the largest producer of milk in the world, there was need for reconsiderations. India has become an exporter even though its exports are less than 1 percent of the world export market. Factors such as international prices of dairy products, producer and export subsidies, exchange rates and cost of milk are the important parameters to make the country competitive in the world market. FICCI (1999) did make preparations for Seattle Ministerial Conference held in 2000 and Doha Conference held in 2002 after holding discussions of various industries.

India is a very minor player in the world market. The country was primarily an import dependent country till early seventies and most of the demand-supply gap of liquid milk requirement for urban consumers was met by importing butter/butter oil and milk powders. But with the onset of Operation Flood Programme, the scenario dramatically changed and commercial imports of dairy products were stopped except occasional imports of very small quantities. Export of dairy products is negligible. The future of Indian dairy industry is promising and its growth potential is high as there is sufficient domestic demand and good scope for exports of milk and milk products. According to consumer survey conducted by the National Sample Survey Organization (NSSO), the consumption of

livestock products, particularly milk, has gained popularity in the last two decades both in the rural and urban areas. Sustained economic growth and increases in per capita income are expected to boost demand for milk and milk products substantially. Apart from this there is a good export market for dairy products. If the dairy industry is to capture the demand-led growth opportunities policy changes are required to improve efficiency and productivity growth at the farm- and firm-levels.

Unified Food Laws: There is need to simplify, reduce and unify the laws governing the dairy industry. The industry for example is governed by the Milk and Milk Products Order, 1992; Prevention of Food Adulteration Act, 1954; the Agricultural Produce (Grading and Marketing) Act, 1937 as amended in 1986 (AGMARK); Standards of Weight and Measures Act, 1976 and the Standards of Weights and Measures (Packaged Commodities) Rules, 1977; Consumer Protection Act, 1986; the Insecticide Act, 1968; the Infant Milk Substitute, Feeding Bottles and Infant Foods (Regulation of Production, Supply and Distribution) Act, 1992 & Rules, 1993 amended in 2003; Bureau of Indian Standards Act (BIS) 1986; Export (Quality Control and Inspection) Act, 1963. The multiplicity of laws and regulations in the food sector leads to overlapping regulations and lack of coordination among implementing agencies. Confounding the confusion in the minds of manufacturers and traders and complicating the task of harmonization with international standards. Therefore, concerted efforts are needed on the part of the central government to amalgamate these acts and minimize the number of enforcing agencies.

International Intelligence and Monitoring: In the introspection section it has been inferred that the developed countries have been more vigilant on the impact that the WTO would have on their sectoral business. It is important that the Indian government and the non-government dairy organizations install a structure and mechanism to gather market information and intelligence; monitor trends in international dairy markets; the international prices; imports of dairy products; domestic support subsidies and export subsidies provided by developed countries; provide relevant information to the government to take corrective actions such as anti-dumping duties, and suitable tariff rates to protect dairy industry from unfair competition. The government should consider setting a standing advisory committee on trade related issues comprising various stakeholders.

Strengthening the Co-operative Dairy Sector: Since co-operatives carry major share of the dairy business in India, it is imperative that the central and the state governments should take effective steps to let them become financially viable and resurgent business organizations. Many dairy co-operatives suffer because of their control either by self-serving bureaucracy and/or by politicized leadership. These issues are as old as the Operation Flood. The NDDB has always found ways to overcome these by bringing about structural changes in the laws and systems governing the co-operatives as well as by providing moral, fiscal, material, manpower and human development support. The need is to continue to improve the functioning of co-operatives without distorting their democratic structure. While the central government is actively disinvesting from the public sector, the co-operative dairy sector is now under pressure of continued financial and management intervention. It is about time that the dairy co-operatives were allowed autonomy to compete, survive and be vibrant or perish. Let the farmers own and manage their organizations keeping their interest central. Any attempt to continue to support would be a futile effort at providing crutches. Greatest strength of the co-operatives has been their milk producer and the rural procurement structure. There is need to strengthen their rural base. A dairy co-operative weak at the rural level is bound to fail in procurement as well as marketing.

Private Dairy Sector to Corporatise: With honorable exceptions, the private dairy organizations in India are family managed businesses. Most of them do not have captive milk sheds for procurement of milk and depend upon small time milk procurement and transport contractors. It is true that nursing a milk shed by enjoining the milk producers to the dairy is an expensive business but it ensures that the quantity and quality of milk received. The quality of incoming milk is not uniform if the dairies procure milk through small time vendors and consequently the quality if milk products from these are not consistent. This causes the dairy plants to function on a seasonal basis. They need to change and adopt corporate culture.

PROSPECTS OF INDIAN DAIRYING

The Strengths and Opportunities: As the Prime Minister of India talks of borderless neighbors, common currency for the South Asian nations, and trains linkages to its neighbors in the west and

far east, the dairy industry dreams of hauling milk to the needy neighbors. The future of Indian dairy industry as a commercial enterprise in the national and international market is promising and its growth potential is high. In the new millennium, the Indian dairy industry is gearing itself to face new challenges and opportunities. Its strength lies in the synergistic partnership forged between the farmer and the dairy professional. This has already given a thrust to the dairy industry to emerge as a full-fledged agric-business.

Growth in Milk Production: India is the highest milk producer in the world contributing 88 million tons to the total milk production of 584.6 million tons (FAO, Rome). India's milk production today accounts for more than 13 percent of the total world output and 57 percent of Asia's total production. Milk production economy is based on conversion of agro by-products and opportunity labor (Khanna, 1999). Therefore the cost of milk production is low. At 20 cents a liter, the farm-gate price of milk in India is one of the lowest in the world. This would increase India's pie in the world total milk production presenting an opportunity for increasing share in the international market.

Economic Growth: Demand for milk and milk products receive a boost from the economic growth-taking place in India. As incomes rise, milk and milk products add to the traditional diet. India has witnessed a GDP growth of 5 percent per annum over the last 10 years and witnessing rapid increase in the rate of growth. During the last quarter ending December, 2003 the GDP growth recorded an unprecedented 8.3 percent. This rate is likely to stabilize between 7 percent and 8 percent. This directly increases the affluence of the middle class who plays important role in bringing food demand to a higher and more advanced level, creating a market for value-added dairy products.

Growth in Population: The world population is expected to increase by 1.5 percent per annum. Most estimates suggest that in 2025, total world population will be between 8.1 and 8.5 billion. The projected growth of 80 to 90 million per year will occur primarily in the developing nations, with Asia, at 54 million, experiencing the most. India will account for 30 percent of the growth in the population base of Asia. More than half of India's population would comprise age group below 25 years.

Increasing Urbanization: Increasing urbanization is expected to expand the potential market for the dairy sector. Presently, only 988 out of 3,700 cities and towns in India are served by its milk distribution network, dispensing hygienically packed wholesome, quality pasteurized milk. Rising awareness about hygiene standards and adulteration of loose milk has led consumers in urban areas to switch to pasteurized packaged milk and this segment is expected to grow at over 8 percent per annum. The effective milk market is largely confined to urban areas, inhabited by 285 million people. Over half of India's total milk production is consumed in urban India. The urban population is projected to cross the 400 million mark by 2011. The expected rise in the purchasing power of growing urban population would give an added boost to the dairy market.

Changing Face of Domestic Market: Food service institutional market is growing at double the rate of consumer market. There is an increasing consumption of food products 'away-from-home'. The concept of parlors is opening new vistas for ready-to-serve dairy products, which would ride piggyback on the fast food revolution sweeping urban India. There is growing market for dairy products as ingredients used as raw material in pharmaceutical and allied industries. In addition to these there is a niche for the defense personnel. A boom is forecast in the defense market of dairy products.

Domestic Demand: India is the world's largest consumer of liquid milk. Milk occupies pride of place as the most coveted food in the Indian diet, after wheat and rice. According to consumer survey conducted by the National Sample Survey Organization (NSSO), the consumption of livestock products, particularly milk, has gained popularity in the last two decades both in the rural and urban areas. India's dairy market is multi-layered, shaped like a pyramid with the base made up of the vast market for low-cost, liquid, raw milk. The narrow tip at the top is a small but affluent market, largely for western-type and fresh packaged dairy products.

Liquid Milk: The bulk of the demand for milk, however, is in urban areas, amounting to some 125 million lpd, accounting for more than 80 percent of traded milk. Herein lies the immense growth potential of the modern organized sector. Presently, the modern milk distribution network supplies hygienically packed quality pasteurized milk to about 1,000 cities and towns. This number could go up by almost five times in the foreseeable future. Accordingly to one estimate, the packed, pasteurized, liquid milk segment, presently estimated at 25 million lpd, would double in the next five years, giving both strength and volume to the modern sector.

Value Added Products: The domestic market for value added products like butter, cheese, ice cream, dairy whiteners and spreads is galloping at 8-10 percent per year. The indigenous dairy products are India's largest selling and most profitable segment after liquid milk and account 50 percent of milk utilization. The market for western type dairy products is estimated at: butter 50,000 tons; branded milk powders: 25,000 tons Ghee in small packs: 32,000 tons; Cheese: 10,000 tons; Infant foods: 100,000 tons. The butter and cheese market is growing between 8 percent and 10 percent annually; the infants foods market is expected to grow at 10-15 percent. As the growth in pasteurized packed liquid milk grows faster, it is likely to retard the rate of growth of branded milk powders.

Branded Ethnic Dairy Products: are witnessing rising demand and increased acceptance, especially among urban consumers. Ethnic products, e.g., sweets, cottage cheese, curd, etc., offer growing opportunity for the organized sector. The success of the branded curd launched under the 'AMUL' brand followed by others like 'Mother Dairy', 'Paras' suggests the potential for introducing such products to the masses. Flavored milk variants of 'AMUL Kool' has given rise to many organized dairies to place milk products in direct competition to branded soft drinks. Amongst traditional ethnic sweets branded products from AMUL, Haldiram, Bikano, Rameshwar, etc., are gaining strength in national and international markets. Significant headway has been made in the industrial production of traditional sweets such as shrikhand, gulabjamun, peda and burfi.

Export Potential: India is a very minor player in the world market. Imports of dairy products is occasional and in small quantities. Export of dairy products is negligible. The most critical issue now confronting the world dairy industry is the fact that world milk production is not expected to be able to keep up with the increasing demand for dairy products? Milk production will grow in Australia, New Zealand, the US, Mexico, Argentina, India and China, but not in the EU, due to supply control system. At 20 cents a liter, the farm-gate price of milk in India is one of the lowest in the World. The native dairy farmer does not receive any subsidy. Hence, the Indian milk products in the post-WTO world can out complete those from many advanced nations that now dominate global markets.

There is an opportunity to market ethnic Indian milk-based sweets. The Indian diaspora comprising some 20 million (Table 4) provide an exciting market. Add to this the strength of people with similar cultures and tastes residing in our neighborhood in Nepal, Bangladesh, Sri Lanka and Pakistan. The highly successful Indian community (Aneja *et al.*, 2002) have an annual income of US$300 billion – almost three times India's GDP. They provide a readymade market. It is interesting to note that 40 percent of all restaurants in Europe and North Americas are "curry" restaurants. If the people can take to the Italian pizza, the Chinese foods and the Indian curries with ease, there is no reason why the Indian diaspora should not be a market for the Indian dairy products. During 2004-05 the GCMMF has touched INR 10 billion of exports of dairy products.

Table 4. Population of Indians Abroad (Millions)

Country/Region	Population
USA	1.6
Canada	0.9
United Kingdom	1.2
Saudi Arabia	1.5
South Africa	1.0
Mauritius	0.7
Myanmar	2.5
Southeast and East Asia	2.0
West Indies and South America	0.9
Australia and the Pacific	0.6
Others	7.1
Total	20.0

Reference: Table 1.1.14 Aneja *et al.* 2002

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4. INDONESIA (1)

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INTRODUCTION

Agriculture has a significant role in the Indonesian economy. As of 2003, the contribution of agriculture to the GDP was 16.6 percent, industry 43 percent and services 39.9 percent. The real growth rate in GDP was 4.1 percent while the GDP per-capita was US$3,200. Indonesia suffered an economic crisis in 1998 which had a negative impact by increasing the number of poor people, with income less than US$2 per day, from 50.1 percent in 1996 to 65.1 percent in 1999. Indonesia took more than six years to recover from this shock. The poverty reduced gradually from 65.1 percent in 1999 to 57.9 percent in 2000, 56.7 percent in 2001, 55.1 percent in 2002, 53.4 percent in 2003 and 51.5 percent in 2004. It is projected to be 49.5 percent in 2005, the situation before the crisis. Poor people are mostly concentrated in rural areas where infrastructures and facilities are inadequate. They have limited access to land, education, capital, inputs and technology. Government efforts in poverty reduction consist of programs on facilitating education, improving facilities and infrastructures, and assisting in capital/credit.

In Indonesia, livestock and agriculture are integrated farming system. Over the last 30 years, livestock has been a primary sector and has made contribution towards the national economic development by providing food, employment, raw materials for the industries and foreign exchange earnings. Livestock has helped in maintaining sustainable economic development, enhancing food security, reducing poverty, conservation and rehabilitation of natural resources and environment, and improving quality of manpower. Dairy farming as part of the livestock sector, has helped in development and improvement of the upstream industries, and generating rural and urban employment.

PRESENT SITUATION OF DAIRY-SECTOR DEVELOPMENT

Dairy sector in Indonesia has been developed since the late 19th century when Frisian Holstein (FH) cows were imported from the Netherlands. The imported FH cows were distributed to farmers and it has become the dominant breed in most of the dairy farms. Since then, dairy sector as part of livestock development experienced rapid growth as reflected in increasing numbers of dairy cattle, milk production, milk processing plants and dairy cooperatives. This growth has a positive impact on the welfare of dairy farmers.

Population and Production

Population of dairy cattle in the country has been increasing over the last five years, i.e. from 332,000 heads in1999 to 368,000 heads in 2003. However, the number of dairy cattle is still the lowest among other ruminants (Table 1).

Table 1. Indonesia – Livestock Population 1999-2003 (000 Heads)

Species	1999	2000	2001	2002	2003
Beef cattle	11,276	11,008	11,137	11,298	11,396
Dairy cattle	332	354	347	358	368
Buffalo	2,504	2,405	2,333	2,403	2,455
Goat	12,701	12,566	12,464	12,549	13,276
Sheep	7,226	7,427	7,401	7,641	8,133

Source: Directorate General for Livestock Production (2003)

Dairy farming is mostly located in rural areas of Java Island, the most inhabited island in the country. There has been an increase in domestic milk production from 436,000 tons in 1999 to 577,500 tons in 2003. The domestic production is still inadequate to meet the demand that has been increasing from 1,116,000 tons in 1999 to 1,350,500 tons in 2003 (Table 2). It has resulted in increase in import of fresh milk.

Table 2. Annual Milk Production and Consumption 1999-2003 (000 Tons)

Parameter	1999	2000	2001	2002	2003 *)
Domestic Production	436.0	495.7	479.9	493.4	577.5
National Consumption	1,116.0	1,400.0	1,262.9	1,266.4	1,350.5
Consumption (kg/capita)	5.09	6.50	5.79	7.05	7.28

*) Preliminary figures 2003
Source: Directorate General of Livestock Production (2003)

Milk Consumption

Milk consumption is not a habit in the Indonesian society. The main consumer is the middle and high-income class because of relatively high price of milk. The milk consumption per-capita has increased from 5.09 kg in 1999 to 7.28 kg in 2003. Milk consumption is very low as compared to other countries (Table 3). Milk is consumed as fresh milk, skim milk, milk powder, etc. Most of the fresh milk is consumed in the rural areas probably due to limited processing facilities. Urban people mostly consume processed milk such as powder milk, yoghurt, etc.

Table 3. Annual Per-Capita Consumption of Milk Equivalent in 2002

Country	Per-capita consumption (kg)
Indonesia	5
Cambodia	13
Malaysia	20
Philippines	20
Thailand	22
Bangladesh	31
United States	100

Source: Rabobank International Indonesia (2002)

Milk Processing and Marketing

Marketing of milk has followed a simple distribution chain involving dairy farmers, cooperatives, processing industries, retailers and consumers. Almost 80 percent of fresh milk produced by dairy farms is sold to the processing industries through cooperatives, 10 percent goes for direct consumption, 5 percent for small-scale processing and 5 percent for other purposes such as cattle feed. There are no milk processing activities, which provide added value at the farm level or at the cooperative level. Dairy farmers rely heavily on the procurement of raw milk by the processing industry.

Most farmers are members of the dairy cooperatives. There were 221 primary cooperatives federated to the only umbrella organization i.e. The Indonesian Milk Cooperative Association (GKSI). The GKSI provides supervision, guidance and service to the primary dairy cooperatives. The primary cooperatives provide services in milk collection, cooling, transportation and technical support to their members. In addition, they provide services for artificial insemination, veterinary health care, feed milling, soft loan and extension.

There are around 31 processors, and 74 percent are situated in Java island where production and consumer centers are also located (Table 4). The companies situated outside Java are small-scale ice cream manufacturers. The main Milk Processing Industries are: Nestle, Frisian Flag, Indomilk, Foremost, Nutricia, Sari Husada, Ultra Jaya, etc.

Since national milk production meets one third of the total demand from milk, the processing industries import skim milk powder (SMP) and other products.

Table 4. Milk Processing Industries in Indonesia

Province	Number of Processors
Java:	
- Jakarta	8
- West Java	10
- DI Yogyakarta	3
- Central Java	2
- East Java	4
Outside Java:	
- North Sumatra	4
Total	31

Source: Rabobank International Indonesia (2002)

CONTRIBUTION OF SMALL PRODUCERS IN DAIRY DEVELOPMENT

National Census showed that there was an increase in the number of dairy cattle households from 56,600 in 1963 to 98,000 in 1993. Most of them are located in Java island (Table 5). The 98,000 dairy households were 2.21 percent of the livestock households numbering 4,435,306.

Table 5. Region-wise Dairy Cattle Households in Indonesia

No	Region	1963	1973	1983	1993
1	Sumatra	11,677	2,379	7,617	1,000
2	Java	38,086	28,082	61,070	97,000
3	Bali and Nusa Tenggara	4,594	419	335	0
4	Kalimantan	999	82	327	0
5	Sulawesi	1,244	416	0	0
6	Maluku and Papua	0	0	247	0
7	INDONESIA	56,600	31,378	69,843	98,000

Source: Agriculture Census (1963, 1973, 1983, 1993), Central Bureau of Statistics

In general, small-scale farmers are the key players of dairy farming in Indonesia. The average number of dairy cattle is 3 to 9 per farmer. Raising animals is a secondary activity of these farmers mostly engaged in cultivating food crops. All members of the family are involved in the activities such as feeding, milking, cleaning, transporting milk to the cooling unit and the cooperative. Milking is manual as the labor is cheap. The average daily milk production is around 10 liters per cow. There are a few medium and large-scale farmers who focus on dairy animals and milk production as a primary activity.

The share of livestock to agriculture GDP over the past five years has increased from 9.18 percent in 1998 to 12.37 percent in 2002; and the contribution to the National GDP increased from 1.59 percent in 1998 to 2.16 percent in 2002.

Table 6. Share (percent) of Livestock to Agriculture GDP and National GDP (1998-2002)

Year	Livestock to Agriculture GDP		Livestock to National GDP		Agriculture to National GDP	
	(a)	(b)	(a)	(b)	(a)	(b)
1998	10.09	9.18	1.71	1.59	16.99	17.35
1999	10.52	11.02	1.80	2.16	17.13	9.61
2000	10.61	12.41	1.77	2.14	16.63	17.23
2001*	10.93	12.36	1.78	2.10	16.24	16.99
2002**	11.08	12.37	1.77	2.16	15.94	17.47

(a) At constant price, (b) At current price; * Preliminary figures, * * Very preliminary figures
Source: Central Bureau of Statistics

CONSTRAINTS FOR SUSTAINABLE DAIRY SECTOR

Development of sustainable dairy sector in Indonesia is facing several issues and constraints along the agribusiness chain of dairy industry involving the production, processing and marketing.

Dairy farming in Indonesia is mostly by the small-scale farmers following traditional management practices passed from generation to generation. They have low level of education, skill and knowledge. Their earnings are low due to small herd size. Livestock is a saving to be sold at any time when the farmers need cash.

Dairy cows are managed under a stall-feeding management due to the limited areas for grazing particularly in Java Island. Feed consists mainly of grasses and agriculture by-products. Concentrate feeds are purchased from the cooperative. Most of the dairy farmers are member of the cooperative.

Postharvest facilities for milk such as milk can, milk container, cooling unit, etc. are limited at the farm level. Usually, farmers deliver fresh milk to the milk collecting point of the cooperative located close to farmer's house. Fresh milk is transported by the cooperative to the milk processing industries. Quality of fresh milk produced by farmers is poor due to high residual contaminants because of poor handling and bad hygiene practices at the farm.

Dairy farmers are highly dependent on the milk processing industries for marketing their produce through the cooperatives. There is a limited technology to process milk and add value at the farm level. Farmers usually make simple value added products from the milk that is not accepted by the cooperative such as caramel, crackers, etc.

GOAT REARING AND ALTERNATIVE DAIRY MODEL: A CASE STUDY

Recently, there has been a growing awareness amongst the dairy farmers to find source of milk production other than cows. Milk producers have found that dairy goat could be a better alternative. Peranakan Ettawah goat is a crossbred between local Kacang breed and imported Boer breed of goat. The crossbred is a dual-purpose goat for producing milk and meat. Raising goat is relatively easy as it requires less capital investment, goat has a faster reproduction cycle compared to cows and the average milk production is 1-2 liters per head daily.

Raising Peranakan Ettawah goat can increase farmers' income and improve milk consumption particularly in rural areas. For intensive goat farming on a large scale there would be a need to create infrastructure support services for breeding, feeding management, credit support and postharvest facilities.

CHALLENGES AND OPPORTUNITIES

Indonesia, like other countries, will soon be faced with harsh realities of globalisation. Indonesia has commitment to eliminate both tariff and non-tariff protection given to the local dairy industry. There would be a severe competition among producing countries in marketing their products.

The current import tariff for milk and milk products in Indonesia is 5 percent and there is no difference between raw materials and processed products. The bound tariff of duty is 40 percent for fresh milk and processed milk, and 210 percent for sweetened milk, buttermilk and fat. Until 1998, the Indonesian dairy industry was under obligation to absorb locally produced milk for producing any value added products. Import of milk was allowed after domestic milk was purchased. After 1998, this obligation was eliminated and since then there has been significant increase in the import of fresh milk to Indonesia.

The trade balance of milk and milk products over the past five years (1999-2003) shows that import of milk products is higher than export (Table 7). Major products imported included powder milk, whey, buttermilk and yoghurt imported mainly from New Zealand and Australia. The products exported were buttermilk and yoghurt mainly to ASEAN countries such as Philippines, Singapore, etc. Continuing and unlimited import would adversely affect local production and the viability of the farmer. It is important for the Indonesian government to impose import tariff to improve capacity building of the domestic dairy farming.

Table 7. Import-Export of Milk and Milk Products to Indonesia (1999-2003)

	1999	2000	2001	2002	2003
			VOLUME (MT)		
Export	16,974	60,742	76,243	34,193	54,907
Import	92,738	164,743	170,152	159,858	169,069
Balance	(75,763)	(104,001)	(93,909)	(125,665)	(114,163)
			VALUE (US$ million)		
Export	17	75	93	55	62
Import	127	254	323	241	271
Balance	(110)	(179)	(230)	(186)	(209)

Source: Directorate General for Livestock Production (2003)

The Government has taken steps to develop and improve the domestic dairy sector. To increase the population of dairy cattle, the government is facilitating import of dairy cattle. A total number of 60,000 dairy cattle have been imported in the period of 1979-1982. The animals were distributed through dairy co-operatives in Java Island. The Government is encouraging development of dairy cattle husbandry and milk processing industries in regions other than the Java Island.

Facilities with better technologies in artificial insemination, embryo transfers, etc., have been created. More facilities for milk procurement, chilling, processing and marketing of dairy products produced by rural dairy farmers are being created. Research and extension are supporting improvement in production and productivity of dairy cattle, and in broadening the knowledge and information base of the farmers.

In the area of animal health and veterinary public health, Indonesia has been recognized by the OIE as one of the FMD-free countries. This is a positive value and would open opportunity for the local livestock industry to compete globally.

There has been a negative perception in the Indonesian society that milk might cause diarrhoea due to lactose intolerance. To increase the domestic milk consumption the Government has initiated a nutritional campaign that targets school children and young generation. The dairy co-operatives and the milk processing industry support the campaign. The campaign aims at educating and encouraging the people for drinking milk as a good source of nutrition and improving health.

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5. INDONESIA (2)

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INTRODUCTION

According to the agriculture census 1993, in Indonesia 98,000 households were involved in dairy farming. Of these 90 percent were smallholders and only 5 percent were large farmers. Dairy farming is concentrated in three provinces of Java island: 26.53 percent in West Java, 31.63 percent in Central Java and 39.80 percent in East Java and 1.02 percent in Yogyakarta province (Statistical Book of Livestock Statistics, 2003). Most of dairy farmers have 3-9 heads of cattle managed by family members, feed and fodder from their own land and capital. They follow traditional management practices and have limited skills, knowledge, and capital. Milk production of local dairy cattle is low, i.e., 8-10 liter per day (2,400-3,000 liter per lactation).

Milk and meat are two important sources of protein for the young. Domestic milk production in Indonesia during 2001 was sufficient to meet 30 percent of the national consumption (Directorate General of Livestock, 2002). Balance was met through imports.

DAIRY SECTOR DEVELOPMENT

Between 1999 and 2003 there has been significant developments in the dairy sector. For example, the number of dairy cooperatives has been static, the cattle population has increased, the domestic milk production and consumption has increased, and import of dairy cattle, milk and milk products has increased. Dairy sector in Indonesia needs to improve production efficiency and productivity through improved feeding, breeding, and disease control, quality of milk and milk products and the competitiveness of the dairy industry.

Dairy Co-operative: Increasing Farmer's Income

The Dairy Cooperative of Southern Bandung (KBPS) was established in Pangalengan, Bandung, and West Java in 1969 with 616 dairy farmers and 2,600 dairy cattle and total milk production around 1,360 tons per year. After 34 years, in 2003, the KPBS had 6,000 farmers, 14,500 heads of cattle and average milk production of 14 liter per day. Daily milk production was 100 tons per day (national milk production 700 ton per day).

Most of the farmers are members of a dairy cooperative. The cooperatives pay to the farmers regularly every 10 days. The cooperative charge the farmers for such services as supply of feed, medicines, water, transportation of milk, artificial insemination (AI) service, etc.

The cooperative supplied raw fresh milk to processing industries in Indonesia to produce powder milk and sweetened milk. The KPBS has diversified into marketing of branded, flavored, packed (in cup) milk through housing complexes and supermarkets. The aim is to add value to milk, make profit and pay more to the dairy farmers.

In 2002, the KPBS has invested Rp 1.5 billion (1 US$ = Rp 9,100) in a new facility, Rp 500 million on hot water cleaning tank. It is expected to added value of 150 million per month. The KPBS handling capacity is likely to increase to 125 tons per day. Of this, 100 tons per day is sold to milk processing industries and 25 tons per day from Pengalengan is processed for a variety of milk-based unique products from Pengalengan. The KPBS has encouraged dairy farmers to improve quality of milk produced by them. Therefore, the proportion of rejected milk, with fat less than 2.5 percent, has decreased to less than one percent every day. The KPBS uses this milk for manufacturing milk chips, yogurt, *dodol, susu,* caramel candy. In the future, the KPBS is planning to produce all kinds of milk products.

Milk Price and Quality

Unhygienic and manual milking, mastitis and unclean barns create in fresh milk, a high bacterial load of 10-20 millions per ml (The Directorate General of Livestock Production, 1999). Milk quality produced by farmers contains 2.8-4.0 percent fat, 6.8 to 8.5 percent solid non fat (SNF) and 9.7-12.5 percent with density 1.020-1.028 and high bacterial content (Talib, 2000). The milk processing industry fixes the price of milk for a minimum fat content of 3.5 percent, SNF 7.5 percent and TS 11 percent. During 2003, the milk price at cooperatives varied between Rp 1,600-1,700 per kg as against the consumer price of Rp 5,000-7,000/liter for the pasteurized milk.

CONSTRAINTS IN THE DEVELOPMENT OF DAIRY HUSBANDRY

National Dairy Institution

Indonesia does not have any national level institution to support and integrate all the functionaries in the dairy sector and to influence the government policies.

Genetic Capacity of Local Dairy Cattle

While purchasing dairy cattle, the farmers give more importance to the purchase price of a cow rather than its genetic capacity to produce milk. There is limited number of cows of Friesian Holstein (FH) breed for replacement of stock. The FH cattle imported from sub-tropical regions generally have low milk production in Indonesian environment. Milk production and quality of local dairy cattle need to be improved through selection and crossbreeding. Smallholder farmer do not pay attention to maintaining performance records, fertile period and mating time. This causes difficulties in breed improvement and the performance of cows.

Artificial insemination has been widely implemented especially in smallholder farming. Effectiveness of the AI is not high because the farmers are not able to identify animals in heat well in time for insemination. There is a need for the smallholder farmers to be trained in use of some cheap method of heat detection. There is a need to introduce use of biotechnology to improve reproductive efficiency, to increase population and to increase milk production. New technologies that should be examined, developed locally and implemented are the super ovulation, embryo transfer, in-vitro fertilization, etc.

Feed and Feed Cost

The animals are fed on forages and concentrates. Forages are derived from pasture under a cut and carry system. The availability of forage is seasonal. It is abundant during the wet season and scarce during dry season. Farmers need to work longer in dry season to cut and carry the forages. Indonesia is dependent on import for raw materials for concentrate feed. However, there are some potential resources that need to be explored by the cattle feed industry. Since cost of feed is the highest in cost of production of milk, efficiency of the smallholder farming depends on reducing feed cost and optimizing the efficiency of milk conversion. The farmers need to learn and apply the latest techniques for feeding the by products of agriculture, agro-industry and undertake to preserve seasonal surplus of forages. They should optimize feeding concentrate to lactating cows according to their genetic capacity, physiological and production status. It is expected that the cooperatives should manage to supply concentrate feed to dairy farmers. As the scale of operations would be larger, the co-operatives can import feed at relatively cheaper price.

Dairy Farming Practices

The farmers need to be trained in proper management practices to increase lifetime productivity of dairy animals. The mortality rate amongst calves is 10-30 percent. The farmers need to learn to take good after birth care, should know the importance of feeding colostrum and manage calves well. The dairy farmers should practice concentrate and fodder feeding according to status of each animal. To improve productivity construction of barn should be specifically designed for tropical condition. Properly constructed barn and farm facilities influence the efficiency of the performance of dairy cattle as well as the dairy business.

Dairy farming is mostly concentrated in Java Island and it creates problems associated with uneven distribution of local milk production. Mapping of potential areas in other regions outside Java Island is necessary. The potential areas should have adequate availability of forages, raw material for concentrates, agro-industrial waste fit for milk production, topography, climate, and marketing channel.

CHALLENGES AND OPPORTUNITIES

Development of local dairy industry is facing many challenges such as: (a) high price of raw material for concentrates feeds; (b) high price for breeding improvement program and frozen semen due to the depreciation of local currency to US dollar; (c) high cost of veterinary drugs and equipments; (d) unsupportive policies of central and regional governments; and (e) high interest rate on credit.

Indonesia is a net importer of milk and milk products. The local dairy industry is unable to meet the high demand of milk and milk products. The opportunities are increasing as a result of increasing awareness in the society that milk is a good source of nutrition and consequently the demand for milk and milk products is growing. The globalization has opened up opportunities to the local dairy industry. Indonesia has been exporting processed buttermilk and yogurt to ASEAN countries. The local milk processing industries are capable to expand and take opportunities to compete in the global market.

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6. ISLAMIC REPUBLIC OF IRAN

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INTRODUCTION

Islamic Republic of Iran has a total area 1,648,195 km^2, one-fourth being saline desert. The area under cultivation is 12 million ha and the rangeland is about 90 million ha. According to its productive condition, the rangeland is classified as good – 10.3 percent, fair – 41.4 percent and poor – 48.2 percent. Total utilizable forage produced by the rangelands is estimated to be 10.7 million tons.

The population of the country was 65.5 million in 2003 with average annual growth rate of 1.5 percent. The rural-urban population ratio changed from 63.53:36.47 percent in 1990 to 33.25:66.75 percent in 2003. Based on 1996 statistics 24.4 percent of labor force was employed in agriculture sector, 29.6 percent in industrial sector and 46.0 percent in public sector. Contribution of animal husbandry sub-sector to agriculture sector is quiet high. About 85 percent of the employees in agriculture sector are engaged in animal husbandry sub-sector, either directly or indirectly. According to 1998 census nomads constituted 1.3 million in about 20,000 households in 101 tribes and 592 independent clans. Nomads' income is completely from animal rearing.

LIVESTOCK AND LIVESTOCK PRODUCTION

Livestock is an important national resource in Iran. More than half of rural production is from livestock and mainstay of livelihood for the smallholder farmer. Often 80 percent of cash income for the small farmer is from livestock. Livestock contributes 43.8 percent of agriculture added value and about 12 percent of gross domestic production (GDP) and about 18 percent of agricultural exports.

The use of animal for draught power and other non-food functions is declining. There is a breakdown of traditional pastoral systems and mixed farming. Livestock production is moving closer to urban settlements and is growing faster in humid part of the country.

The increasing demand for livestock-based food products is changing the trend for keeping animals for multi-purpose to single-purpose animals. Another trend is the growing importance of poultry as economic converters of concentrated feed.

The most common species of farm animals are sheep, goats, cattle, buffalo and camels. Application of the development plan in animal production resulted in a considerable increase in milk, red meat, poultry meat, eggs and fish during the last two decades (Table 1). Guaranteed and remunerative producer-prices for major commodities have been the essential policy tool behind such performances.

Table 1. Livestock Production: 1982-2003 (1000 tons)

Year / Products	1982	2003	Annual growth (Percent)
Milk	2,850	6,300	5.8
Red Meat	430	752	3.8
Poultry Meat	265	1070	14.0
Eggs	245	620	7.6
Fish	160	400	7.5

Technological changes are creating modern and capital-intensive production chains for poultry meat, eggs and dairy products, leaving the traditional and labor-intensive sector to smallholder farms.

The contribution of livestock to the economy has been largely underestimated. Although the relative importance of livestock is decreasing, yet they will continue to provide the wide range of human needs. The major challenges are to increase livestock productivity, quality of products, and access to market, maintaining food security, alleviating poverty, sustaining the environment and protecting human health.

Sheep and Goats

The number of sheep and goats is about 71 million animal unit (Table 2). Sheep and goats produce about 65 percent of red meat consumed in Iran. There are 26 known breeds of sheep and 9 breeds of goat adapted to different geographical regions. Apart from the Zel breed, which is reared near the Caspian Sea, all other indigenous sheep breeds are fat-tailed. In general, sheep are mainly bred for meat, milk and wool, with the exception of pelt breed of Karakul.

Flocks are mainly managed under village and migratory (nomadic) systems. In both systems the animals are mostly kept on natural rangelands and pasture and farmlands with a little supplementary feeding. The herd size of more than 78 percent of family is less than 50 animals.

Table 2. Livestock Numbers (*1000) in Iran, 1992-2002

Year	1992	1996	2002
Sheep	47,732	51,499	51,650
AU	47,732	51,499	51,650
Goats	24,752	25,757	25,526
AU	18,564	19,318	19,145
EB (Exotic Breeds) Cattle	355	500	650
AU	3,372	4,750	6,175
CB (Cross Breeds) Cattle	702	1,303	2,216
AU	4,563	8,470	14,404
LB (Local Breeds) Cattle	5,531	5,123	4,494
AU	22,124	20,492	17,976
Buffalo	305	336	374
AU	1,982	2,184	2,431
Camel	142	143	146
AU	781	787	803
Others	1,537	1,680	1,727
AU	6,917	7,560	7,772
Total: AU	106,036	114,416	120,356

AU: Animal Unit. 1 AU = 1 Sheep of about 45 kg; .75 goat; 9.5 EB Cattle; 6.5 CB Cattle; 4.0 LB Cattle; 6.5 Buffalo; 5.5 Camel; and 4.5 other livestock.

In the nomadic system, flocks migrate in the summer from low land (winter ranges) to higher mountain grazing area. Nomadic tribes comprised about 1.3 million of people in 2002, and they reared 13.2 million sheep and 9 million goats. In recent decades, there was a gradual drop of nomadic population from 38 percent in 1966 to about 2 percent of total population in 1988. The nomadic population is decreasing as they are being settled in different parts of the country. Stall-feeding is not common among the nomadic tribes and periodic droughts have resulted in high mortality and low productivity. Only the animals that are well adapted to harsh environmental conditions survived. Therefore the breeding programs common in intensive production systems, such as selection for higher productivity, are not applicable in nomadic conditions.

In the village system, flocks are grazed on natural communal pastures and irrigated or non-irrigated land. About 77.4 percent of total sheep and goats are reared in this system. In some parts of the country sufficient fodder and feed is available throughout the year from good rangelands, harvested forages, grasses and agricultural by-products. In some villages, animals get supplementary feeding throughout the year especially in the winter. Programs for improving animal productivity are promising

in this system. Breeding, feeding and management program, new technologies and also range management are practiced through cooperatives and individual producers.

Fattening feedlots, where sheep and cattle are intensively fed, could also be included in the category of supplementary feeding. In this respect commercially prepared pellets and concentrate mixtures are of special importance.

The effect of low-quality forges is accentuated by seasonal variation. The growing season is from March to June. Some pastures in lowlands are preserved for next autumn, when nomads return from highlands. During the dry season, from June/July until September/October, grasses of high fiber and low protein content are fed. In summer season stubble is supplemented with barley. At the beginning of the growing season, grasses contain on average 9-11 percent crude protein and their digestibility is about 60-65 percent. These values decrease rapidly during the dry season and the protein content is only 4-5 percent and digestibility between 45 and 50 percent.

The present system of nutritional management, which largely depends on natural vegetation, is unsatisfactory. On the one side, there is a sizeable gap between actual and potential productivity of small ruminants, on the other side, lack of suitable feeding strategies results inefficient use of available feed resources. An intensive feeding system may give higher outputs, but it needs a large amount of high quality concentrate mixtures.

Semi-intensive system is practiced in some agro-industrial farms that cultivate different crops and produce suitable feed for animals. Small ruminants are fed on crop residues when the roughages are abundant. In these systems, it is possible to rear large size and high productive breeds of sheep and goats, and apply new techniques of breeding, nutrition and production. In order to overcome present nutritional problems of poor ranges, small ruminants should be taken off the ranges as much as possible to reduce grazing pressure and to allow regeneration of range grasses. It is suggested that the present extensive system of production should be gradually changed to a more productive semi-intensive system.

A 10-year national plan was launched in 2001, which aimed to reduce the number of grazing animals and balance productivity with carrying capacity of rangeland. More attention is being paid to increase concentrate to overcome the nutritional problems of poor ranges. At the same time, increase in number of grazing animals is prevented. More attention is being paid to fibrous crop residues and agricultural by-products as main feed resources. In a longer term, it is expected that these strategies will lead to a reduction in number of animals without affecting total production.

Cattle

At present, there are three categories of cattle breeds: native breeds, exotic breeds and crossbreds of native and exotics. About 4.5 million native cattle are reared in villages using traditional systems (Table 2), where the average herd size for each family is about 5 to 7 cattle. They graze on natural communal lands or on irrigated farmland. Genetic selection is not practiced and mean body weight and level of production vary between different generations. Local breeds are suitable for extensive production systems and their body size, growth rate and productivity are in accordance with the present level of management. The birth weight of calves is about 15 to 20 kg and the mature live weight of male and female cows is about 370 and 275 kg, respectively. The average milk yield, in 150 to 160 days of lactation period, is 600 to 900 kg with a fat content of about 4 percent. Native cattle produced 17.9 percent of total milk production of the country in 2003.

Crossing native breeds with high producing exotic cattle (mainly Holstein breed) has improved milk production. For example, the milk yield of F1 offspring in one lactation period is about 2,400 kg. Due to the government policy for increasing milk production, the number of crossbred cattle has increased rapidly during the last ten years. Crossbred cattle produced about 36.7 percent of total milk in 2003. Crossbred cattle, which are reared in small farm, are usually grazed on pastures in spring, fed crop residues of harvested crops during late summer and early autumn, and are kept in stable and fed roughage, barley and wheat bran in late winter.

Exotic cattle breeds such as Holstein, Brown Swiss, Jersey, Guernsey, and Red Danish were imported about 50 years ago. Of these, the Holstein is most popular (about 94 percent), while a few dairy farms use Brown Swiss and Jersey breeds. The population of pure exotic dairy cattle is about 650,000 and there are about 2,300,000 head of native and exotic crossbreeds. The infrastructure necessary for genetic improvement of these cattle, such as pedigree registration, recording the traits and artificial insemination was developed 40 years ago. The animal breeding center of Karaj is in charge of

milk recording, data analyzing, breeding value estimation, semen collection, freezing semen and its distribution among the farms. The productivity of industrial dairy herds has generally improved to acceptable levels over the past 20 years. Now-a-days average daily milk production of exotic breeds is about 24 kg per cow. These herds, which are under the milk-recording program, use semen of proven sires through artificial insemination and/or embryo transfer techniques.

The most common feedstuffs used in commercial dairy farms are alfalfa, maize silage, wheat and barley straw; concentrates mainly consisting of barely grain, maize, wheat bran, sugar beet pulp, cottonseed meal, soybean meal, molasses, fat and mineral supplements. In these farms animals are fed indoors and grazing in rangelands or farmlands is not common. Many of these dairy farms do not have enough land to produce feed. They purchase all or part of their required feedstuffs from the market. Therefore, these systems are highly influenced by feed price changes in different seasons and years. The prices of feedstuffs are highest in the autumn and winter. The price of hay is related to the price of barley and when there is a shortage of barely, the price of roughage increases.

Dairy and feedlot farms in the suburbs are being forced to move out as urban areas expand. Therefore, the government has managed a project, through which land and other basic necessary facilities for production are provided in areas away from cities. The government also has programs to establish new laboratories for feed analysis and evaluation, recording systems, cattle and buffalo semen and embryo production.

FEED RESOURCES

Feed supply is the most important limiting factor for animal production in the country. It is estimated that in 2003, about 60 million tons of feeds were used by the various ruminant species but available feed does not meet their nutrient requirements for optimum production. Pastures and rangelands provide about 30 percent (17.5 million tons) of the feed but are insufficient to meet animal's requirements. Straws comprise about 23 percent (14 million tons) of the feed. Forages provide about 16 percent (10 million tons), while about 19.5 million tons of good quality forages are required. Concentrates, by-products of industrial plants and other feedstuffs (such as wheat bran and middling, sugar beet pulp, oilseed meals, barley, etc.) are about 30 percent (18 million tons) of the available feed.

The Iranian feed industry is about 40 years old. The total feed production is about 2 million tons, which is about 40 percent of capacity partly due to shortages in raw ingredients. Poultry feeds are the greatest proportion followed by cattle, sheep and fish feeds. Export of manufactured feeds is not high. Some feed-mills have modern computerized systems, the latest equipment for analytical procedures, and use the latest manufacturing technology. Feeds produced by these plants are of international quality standards.

MILK PRODUCTION

Total raw milk production in the country was 6.3 million tons from various types of livestock in 2003, with per capita milk consumption of 75-80 kg. The world milk production has increased by 46.2 percent within 10 years (Table 3). The main reasons of increase in milk production in Iran are (a) use of higher genetic potential animals and sperm from the exotic cattle, (b) increasing the ratio of crossbred cattle to native breeds and (c) increasing number of milk collection centers.

Table 3. Milk Production Trend: 1993-2003

Year	1993	1998	2003
Milk Production (million tons)	4.28	5.10	6.3
Milk Availability Per Capita (kg)	74.4	82.6	95
Population in million	57.5	61.7	66.5

This increasing milk production has helped in the development of milk products industry. About 65 percent of total milk production is processed by milk processing factories. There are 51 large dairy plants with 2.5 ton per hour capacity. Fifteen of them belong to government owned Iranian Dairy Industry Company and others belong to the private and semiprivate sectors. Most of these factories have

capacity to receive 75-150 ton milk per day. The government sector dairy plants supply subsidized milk. There are 289 privately owned small milk-processing factories, mostly small white cheese workshops. A survey indicated that another 207 private plants were under construction. In addition to these factories thousands of very small traditional units and smaller seasonal units also contributed to dairy processing.

The large factories produce yogurt, butter and cheese, while traditional milk-processing workshops produce large quantity of yogurt and cheese. The policy of government for increasing milk products has encouraged the private sector for investment in establishing milk-processing factory. Total processing capacity is estimated at 2 million-ton milk processing per year and the government has justified creation of another one million ton.

The import of milk and milk products has declined as result of increase in milk production. Cheese production has increased in the recent years and Iran has become self-sufficient in cheese production. She may even start exporting. The expansion of cheese factories has helped producing many types of cheese the majority being white cheese. Recent years Iran has started producing dry milk.

RECOMMENDATIONS

While livestock provides a wide range of human needs, its contribution to the economy has been largely underestimated. It is predicted that demand for animal products will increase rapidly in the near future. The growth in intensive livestock production, particularly poultry, has seen increased demand for animal feeds to be imported or produced in the country.

There is a need for simple and low cost technologies for livestock and product processing. As various technologies developed and are adapted to variety of conditions, smallholders are not able to use them.

Protection of environment is critically important. The true cost of production, including the environmental cost must be considered as a factor. The developing countries need to rapidly increase livestock productivity to help their growing populations without depletion of natural resources.

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7. REPUBLIC OF KOREA

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INTRODUCTION

Historically, dairy industry in Korea started developing from 1960's. In accordance with its dairy development plan, the government of Korea imported dairy cattle from Australia, New Zealand and Canada. Milk plants were established to process liquid milk and dried milk. The government started school milk program to promote the habit of drinking milk amongst children. In 1965 Korea had 87.7 percent small-scale dairy farms, having less than 10 dairy cattle and the rest of the farmers owned less than 20 dairy cattle (Table 1). Between 1970 and 1980 the Korean dairy industry grew at a fast rate of 25 percent per annum in milk production and consumption. From 1980 to 1997 the milk consumption increased at 10.9 percent per annum. Increase in dairy cattle was 6.7 percent. Various dairy products like fermented milk products, cheese, butter and modified dried milk for baby were developed. Under agreement with the World Trade Organization Korea dismantled all trade barriers. Consequently, there was increase in import of dairy products. This compelled the Korean dairy industry to become competitive and face the challenges of globalization.

Table 1. The Scale of Dairy Farms in Korea

Year \ Cattle		1-9	10-19	20-29	30-49	+50	Total	Average Cattle per Farm
1965	Number	1,061	149	-	-	-	1,210	5.5
	(Percent)	(87.7)	(12.3)				(100.0)	
1975	Number	6,921	1,580	444	272	198	9,415	9.1
	(Percent)	(73.5)	(16.8)	(4.7)	(2.9)	(2.1)	(100.0)	
1985	Number	30,997	8,825	2,399	1,127	412	43,760	8.9
	(Percent)	(70.8)	(20.2)	(5.5)	(2.6)	(0.9)	(100.0)	
1995	Number	3,525	7,315	6,622	4,696	1,325	23,519	23.5
	(Percent)	(15.0)	(31.2)	(28.2)	(20.0)	(5.6)	(100.0)	
2004	Number	523	797	1,204	3,131	4,480	10,135	50
	(Percent)	(5.2)	(7.8)	(11.9)	(30.9)	(44.2)	(100)	

STATUS OF SMALL PRODUCERS

During the development and growth period Korean small-scale dairy farmers having 12-15 cattle per dairy farm played a significant role. From 1990 onwards it became difficult for the small dairy farmers to survive and large-scale farms played important role in milk production (Table 1). With the opening up of the Korean market and economy, there was increase in the expenditure on controlling the pollution caused by dairy cattle, increase in the price of feeds and fodders, on labor cost and there was gradual decline in the income per animal. Therefore the small farmers were forced to abandon dairying. Only the farmers with larger number of animals could survive. This tendency was also seen in the other sub-sectors of agricultural. The government also preferred development of specialized large-scale farms to enhance the competitiveness. Consequently, in 2004 the number of dairy farm reduced to 10,135 and average number of cattle per dairy farm records increased to 50 which is almost equivalent to any typical European farm. This trend towards large-scale farming helped to increase the productivity of dairy farmers and is expected to continue in the future. It is also expected that the number of dairy farms might reduce to 5,000 in the near future.

Similarly, the dairy processing industries of Korea is also facing intense competition. Milk plants with lower productivity and profitability are closing and the larger dairy plants whose scale of economy helps to increase the productivity and profitability are sustaining in the market.

MILK PRODUCTION AND CONSUMPTION

The number of dairy cattle and dairy farms is declining but the milk production has been increasing to large extent (Table 2). The improvement in productivity of dairy cattle is attributed to improved feeding, production of good quality roughage, and intensive management of dairy animals. However, the use of BST needs special mention.

Table 2. The Number Dairy Cattle and Productivity per Cow in Korea

Particulars	1980	1990	2000	2004
No. of Dairy Cattle	207,000	503,000	540,000	509,146
Milk Production per Cow (kg)	4,156	5,363	5,700	7,102

Increasing milk production has caused the problem of the availability of surplus over the market consumption. Despite surplus milk availability, the price of raw milk increased by 13 percent during 2004. From the farmers' standpoint, the increase in the price of milk was imminent because the production cost had increased. However, there is need to reduce the production cost of milk.

To balance the milk demand and supply in the market, the government has taken many introduced policy initiatives, e.g., (a) introducing quota system for production of milk according to the size of the dairy farm; (b) surplus milk is purchased by the Dairy Promotion Association; (c) increased slaughter of dairy cattle to reduce the farm size; (d) export milk powder to North Korea; and (e) subsidizing supply of surplus milk to the military.

The nutritional value of milk is well recognized by the Koreans and is considered as an indispensable food. The problem of lactose intolerance is being coped by promoting consumption of fermented milk products. In the younger generation, who has already habituated to consuming milk, lactose intolerance is not a serious problem. Milk consumption is confined nearly to liquid type milk and fermented milk. While the liquid milk is produced from freshly produced milk, the flavored milks are produced from imported skimmed milk powder as raw material. It is apprehended that recombined milk or reconstituted milk produced from the imported milk powder can become a serious problem for the Korean dairy industry.

Table 3. Consumption of Milk in Korea (Tons per Annum)

Year	Raw Milk	Liquid Milk		Flavored Milk	
1963	3.190	2,228	(69.8)	962	(30.2)
1965	8,851	6,425	(72.5)	2,426	(27.5)
1969	32,430	13,032	(40.7)	19,407	(59.3)
1973	101,819	55,671	(54.7)	46,168	(45.3)
1975	160,338	116,813	(72.9)	43,525	(27.1)
1980	452,327	258,587	(57.2)	193,740	(42.8)
1985	1,005,812	714,370	(71.0)	291,441	(29.0)
1990	1,751,758	1,305,825	(74.5)	445,933	(25.5)
1995	1,998,220	1,490,873	(74.6)	507,347	(25.4)
2000	2,252,804	1,696,848	(75.3)	555,956	(24.7)
2001	2,338,874	1,729,331	(73.9)	609,543	(26.1)
2002	2,536,648	1,664,329	(65.6)	872,319	(34.4)
Average		(66.9)		(33.1)	

There has been gradual increase in the per capita consumption of milk and milk products. It has been 47.5 kg in 1995, 49.4 kg in 1998, 59.6 kg in 2000 and 62.4 kg in 2003. Based on the proportion of domestic production to imports the rate of achieving self-sufficiency has been 93.2 percent in 1995, 88.2 percent in 1998, 80.1 percent in 2000, 76 percent in 2001 and 2003. It should be noted that while

per capita milk consumption is increasing steadily, the self-sufficiency rate is decreasing. During last 35 years, Korean dairy industry has shown a remarkable development. This was possible because the Korean market was protected against import of foreign products. Korean market is now completely opened. This is also seen in the increased tendency to import of milk products particularly the dried milk powder. The current tariff on import of dried milk powder is 220 percent and it is likely to be reduced to a great extent. The rate of tariff on import is not a deterrent because the international prices of milk products are far lower than the prices of domestically produced milk products (Table 4). If the tariff and subsidy were reduced under pressure from the WTO, there would be substantial increase in import of milk products from the Oceania countries and the United States. There is another potential problem likely to be faced by the Korean dairy industry. Because of the high tariff on milk powder, there has been increase in the import of imitated milk powder. This can become a potential problem for the survival of the Korean dairy industry.

Table 4. Comparison of Domestic and International Prices of Milk Products in Korea

Milk Product	Domestic Price (A)	International Price (B)	A / B
	Won/kg (1$=1200won)		
Skim Milk	6,400 (5.33 $)	2,064 (1.72 $)	3.1
Butter	6,750 (5.625$)	2,752 (2.293$)	2.5
Cheese	7,590 (6.325$)	3,263 (2.719$)	2.3

Since 2000, the consumption of cheese has rapidly increased in Korea (Table 5). Similarly the farmers in the rural areas are increasingly producing farm made cheese that can be supplied to the consumer as a value added product. This also created more rural jobs and increased the farm income. As part of the green tourism, it can provide an opportunity for the travelers to experience the cheese production. It is necessary to train the farmers in this venture.

Table 5. Import and Consumption of Cheese (Ton) in Korea

Year	Imported Cheese	Natural Cheese	Processed Cheese
1990	123	3,204	3,509
1996	15,022	14,089	6,457
2002	31,942	29,978	22,378

QUALITY OF MILK AND PAYMENT SYSTEM

Payment for the raw milk according to its quality was introduced in 1993. Quality of milk was classified based on the somatic cell count (SCC) in milk (Table 6). The standards for quality based on SCC have been revised over the period to bring about gradual and continuous improvement. For example, there were only three classes of milk between 1998 and 2001. As the consciousness for better quality of milk increased, standard was revised to declare five classes of milk. While first class milk was to have SCC of less than 200,000 per ml, the fifth class had SCC of more than 750,000 per ml. It has been observed that to produce first class milk according to the recommended level of SCC is very difficult. During 2003, more than 36 percent of milk had more than 500,000 SCC/ml, which indicates that a large population of dairy cattle might have suffered mastitis. Measures are needed to reduce the SCC milk.

Table 6. Quality of Milk Based on Somatic Cell Count (SCC) in Raw Milk (%)

Year	1998	1999	2000	2001		2002	2003
1st class (<200,000)	19.0	17.8	21.0	21.7	1st class (<200,000)	25.7	31.7
2nd class (<500,000)	55.0	53.7	50.9	48.7	2nd class (<350,000)	42.0	32.2
3rd class (≥500,000)	26.0	28.5	28.1	29.6	3rd class (<500,000)	21.8	17.4
					4th class (<750,000)	6.5	11.5
					5th class (≥750,000)	4.0	7.2

SUSTAINABLE DEVELOPMENT OF THE DAIRY SECTOR

For rapid economic development, the government invested heavily in the urban areas, particularly Seoul the capital of Korea. This resulted in concentration of the population in the capital city and other large city areas. This tendency was also reflected in the growth of the dairy farms. Most of the dairy farms got concentrated in the urban area. Discrepancy in development between urban and rural area is now a serious problem in Korea. Scarcity of cultivable land and high cost of labor in the urban areas made cultivation of fodder a prohibitively expensive proposition. Therefore, the Korean dairy farms have to depend on imported roughage. The cost of milk production has been rising because of shortage of labor, dependence on imported feed and fodders, increasing dairy waste. On one hand it is expensive to shift the dairy waste for use as manure in the rural areas and on the other it is prohibitively expensive to control pollution caused by the dairy waste. Selection of cows is based on traits of milk and meat production. The animals are fed to produce maximum milk and beef. The high productivity weakens the physical conditions of dairy cows if they are no well fed.

In early stage of Korean dairying, pollution due to dairy waste was not a serious problem because the small-scale farmers contributed the most to milk production. As the size of dairy farms increased, environmental pollution due to manure became more of a problem. Although the manure from dairy cattle can be used as a fertilizer, this is hardly realized in Korea. Instead, the manure is regarded as the main source of pollution. The regulations concerning manure and wastes from livestock is now being made stricter. Therefore, the cost disposal of animal waste has increased and it is adding to the production cost of milk. The efforts are ongoing to utilize the manure as a resource in the form of fermented liquid fertilizer. Efforts are also being made to use rice paddy as roughage. This project would be helpful to reduce the milk price and to prolong the economic life of dairy cows. However, the success of the project is questionable. One of the important purposes of dairying is to make the best of idle land. This purpose is not yet fully realized in Korea.

Most of the young population has shifted to urban areas for employment. The aged people comprise main labor source in rural areas. Since they cannot work hard the quality labor and consequently the cost of labor increases. More than 40 percent of dairy farmers in Korea are above 50 years of age. In the absence of young to stay in rural areas agriculture and dairying as a profession is not able to find successors. Sustaining agriculture and dairying is becoming increasingly difficult in Korea.

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8. MALAYSIA

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INTRODUCTION

The consumption of *dadeh* (sweetened curdled whole milk) by the Malays in Kedah indicates that milk from buffaloes, cattle or goats was known well before the arrival of migrant Indians who brought dairying as a business to Malaysia in the early 1900's. For the migrant Indians major source of income was from plantations and dairying was a subsidiary activity for the landless. Except for the marginal feeding of cut forage, cattle survived on grazing along roadsides and reserve lands. The migrants brought Ongole, Hariana, and Red Sindhi and Tharparker cattle, now referred to as Local Indian Dairy (LID) breed. Successful European style dairy farms were set up with imported Friesian, Jersey and Ayrshire cattle in the highlands near Kuala Lumpur. The exotics kept in tropical lowland climate failed and this lead to a general belief that "the tropics were not the place to produce milk". It was in the 70s that the favorable Government policies helped to develop a viable dairy farming sector.

FARMING SYSTEMS

While the total cattle population has been increasing, that of the dairy cattle and cows has been steadily declining over the years (Table 1). It is believed that urbanization and competition from oil palm and rubber plantation has marginalized dairying to unsuitable lands. The livestock extinction has been at the rate of 23 percent but the replacement rate was only 15 percent. Imported animals have managed to stabilize the replacement rate.

Table 1. Dairy Cattle Population in Malaysia

Year	Cattle Population	Dairy Population	Dairy Cows
1972	330,000	71,543	NA
1999	662,015	36,251	13,474
2003	698,705	27,953	9,519

Smallholder farmers supply 57 percent of domestic milk production. Average per family holding is 1-10 cows giving 1,000-1,500 liters per lactation. The cows have long calving interval and the age at first calving is three years. The cows are hand milked twice a day, kept indoors and sent for grazing. The stables vary from very simple ones built of poles and thatched roof to improved ones with concrete walls with a roof of iron sheet.

The traditional cow keepers have practiced semi-commercial and commercial scale farming. They contributed 38 percent of the domestic milk production. Their farms were better organized, used modern techniques such as portable milking machines and line system to milk cows twice daily. Cows were always given concentrate feeds. Their average yield per lactation was 2,400 liters, replacement calves were kept and cows with poor performance were periodically culled. Farmers preferred AI to natural service, if available.

The statistics of income distribution of farmers over the last decade showed that there has been gradual decline in the number of small farmers and the proportion of large farmers with income above RM 3,000 has gone up from 4 percent in 1993 to 30 percent in 2003 (Table 2).

Similarly, participation in DVS-MCCs by semi commercial and commercial scale farmers has increased from 47 percent in 1998 to 63 percent in 2003 (Table 3).

* Ms. Roslaini Rusli did not attend the seminar but submitted a country paper.

Table 2. Number of Dairy Farmers according to their Income

Year	Income Distribution			
	<RM 500	RM 501-1000	RM 1001-3000	>RM 3000
1993	471 (48 %)	216 (23 %)	245 (25 %)	38 (4 %)
1998	44 (12 %)	127 (34 %)	2 (0.5 %)	194 (53 %)
2003	73 (14 %)	76 (15 %)	216 (41 %)	157 (30 %)

Table 3. Farmers Participating in Milk Collecting Centers

Year	Smallholder	Semi commercial scale		Commercial scale
	<10 cows	10-29 cows	30-49 cows	>50 cows
1998	417 (53 %)	330 (42 %)	44 (5 %)	
2003	302 (37 %)	241 (30 %)	205 (25 %)	60 (8 %)

DAIRY DEVELOPMENT PROGRAM

In 1971 the Third Malaysia Plan adopted the new economic policy with the twin objectives of poverty eradication and restructuring of society. In 1984 the National Agriculture Policy (NAP) provided guidelines to maximize utilization of resources; maximize farm income and that agricultural production should based on economic consideration. Livestock development concentrated on production of beef, pork, mutton, milk, poultry, and eggs within the country. Clause 29 of NAP stated, "In the case of dairy products, the major part of the demand will continue to be met by imports. The local production of fresh milk will be maintained to meet domestic demand".

In 1974, the Department of Veterinary Services (DVS) introduced Dairy Development Plan to develop small-scale dairy activities amongst the rural farmers to meet the local demand for fresh milk. The DVS recognized that major problems were that: Malaysian dairy cattle were poor in milk production, there was scarcity of feed and fodders, the farmers had small landholding, lacked knowledge of modern practices, needed credit and loans and there were no facilities for marketing of rural produce at reasonable prices. Recognizing these limitations a package Dairy Development Program was implemented in three phases.

Phase I: the development phase focused on the establishment of milk chilling centers (MCC) for purchasing milk from the farmers. At the MCCs basic facilities were created to provide a package of services including training in animal husbandry, home plot development, artificial insemination, health care, basic accounting and data maintenance. The farmers were given credit to purchase cattle feed and milking accessories. During the 80s, Frisian Sahiwal crossbreds were imported from Australia and New Zealand and these were given to complement the LID cattle owned by the small dairy breeders. The soft loan at subsidized interest rate was facilitated to breeders. In the Skim Pawah Ternakan area farmers were provided with two free pregnant cows with the condition that the first-born calf would be returned to the state.

Phase II: the consolidation phase provided facilities for pasteurization, and marketing of rurally produced milk, improved the efficiency and productivity of the MCCs and the farmers.

Phase III: the stabilization phase consisted of institution building, with major emphasis on improving the quality and efficiency of the MCCs and the farmers. The farmers' organization and cooperatives will be encouraged to take over the responsibilities of MCC.

Genetic Improvement: The DVS has developed six farms to function as research, training and breeding units for the dairy cattle. These farms have improved grazing pastures, facilities for semen of exotic breeds for crossbreeding with LID cattle, facilities for artificial insemination service. The research at these farms has established that 50-75 percent Friesian – Sahiwal crossbreeds, called Mafriwal breed, were ideal for milk production.

The achievements of the dairy program have been encouraging. At inception, MCCs had 7,300 registered farmers (Mustaffa *et al.*, 1991), of which 3,000 farmers were active in dairying and 30 percent of those sent their milk to the MCCs. Over 7,000 farmers have been trained in basic dairying.

Between 1975 and 1991, 14,708 crossbred dairy heifers and pregnant cows were distributed to participating farmers. As the program expanded, quantity of milk collected by the MCCs increased. Major expansion had occurred in 1981-82 when dairy cows were imported and distributed. Volume of milk collected increased from 5.4 million liters in 1982 to 11.5 million liters in 1987 and 18.9 million liters in 2003.

Farm Gate Price of Milk: The ex-farm price of milk has been increasing according to market forces and trade influence. The price per liter paid by the DVS chilling centers have been: RM 0.70 in 1980; RM 0.72 in 1985; RM 0.80 in 1989; RM 1.05 in 1999 and RM 1.35 in 2002. During 2003 the purchase price was RM 1.23 per liter for milk containing 3.25 percent fat; 8.5 percent SNF giving a total TDS value of 11.75 percent and total plate count (TPC) of <0.25 million per ml. The incentives and penalties applied on the basic price were:

Total Plate Count	Penalty
<0.25 M per ml	Nil
0.25 to 0.5 M per ml	RM 0.15 per Liter
0.50 to 1.0 M per ml	RM 0.30 per Liter
Total Dairy Solids	**Bonus**
TDS: >12.25 percent	Bonus of RM 0.06 per Liter
TDS 12.50 percent	Bonus of RM 0.12 per Liter

Farmers have been encouraged to market their milk directly instead of depending on the DVS. Therefore, the vendors and the farmers have practiced door-to-door sale of milk. During 2003, the price of milk sold in the open market varied from RM 2.40 to RM 4.00 per liter depending on the locality and season.

CONSUMPTION PATTERN OF MILK AND MILK PRODUCTS

During 2003, liquid milk constituted less than 10 percent of the total consumption of milk and products market. Milk powders including infant milks and condensed milk were the major products consumed in Malaysia. The domestic milk production met with 36.5 percent of the domestic consumption of the liquid milk market. In 2002 the composition of dairy products consumed by the population was as shown in Figure 1.

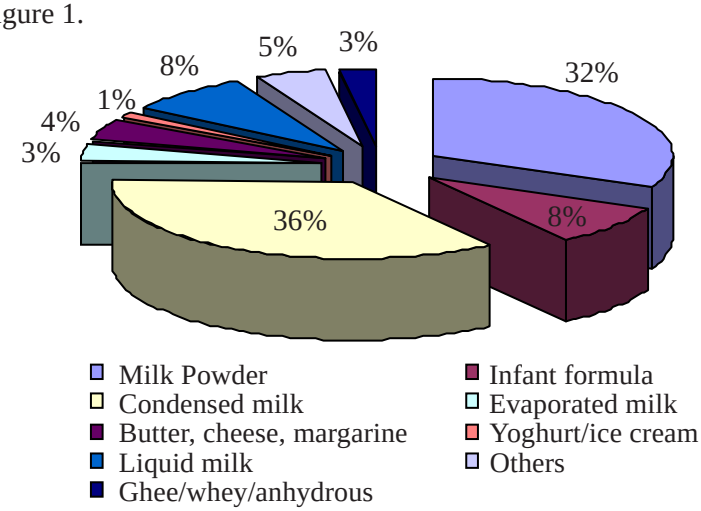

Figure 1. Consumption Trend 2002

THE WAY FORWARD

In 2003, domestic milk production in Malaysia was 28.5 million liters and contributed 2.45 percent of the domestic consumption of 1,248.1 million liters of liquid milk equivalent (Table 4). More than 97 percent of the domestic requirement was therefore met from import of milk and milk product.

Because of low domestic production and high consumption of milk and milk products, the milk processing industry has developed and grown on imports (Table 4). Import of dairy product constituted 27.45 percent of the total livestock import valued at RM 1,167.04 million in 2002 (Table 5).

Table 4. Domestic Production and Consumption of Milk and Milk Products in Malaysia (in Liquid Milk Equivalent)

Year	Per capita (Liters per annum)	Domestic production (Million liters)	Domestic consumption (Million liters)	Self-sufficiency level (Percent)
1998	35.22	27.28	611.31	4.46
1999	40.76	23.94	722.37	3.31
2000 ®	56.62	24.42	1,025.73	2.38
2001 ®	68.99	25.19	1,321	1.91
2002 ®	(P) 63.86	30.56	1,248.1	2.45

® Revised Estimates; (P) Provisional Estimates
Source: Annual Statistical Reports of the Department of Veterinary Services

Table 5. Value and Quantity of Import and Export of Milk Products

Year	Import		Export	
	RM Million	Tons LME	RM Million	Tons LME
1998	927.81	896	349.61	311.98
1999	1,014.79	1,054.02	358.84	355.59
2000	1,153.03	1,210.06	219.11	208.75
2001	1,413.39	1,510.14	230.34	214.71
2002	1,167.04	1,428.45	225.35	210.85

CHALLENGES AND OPPORTUNITIES FOR THE MALAYSIAN DAIRY INDUSTRY

The 1998 economic and financial crisis that hit East Asian nations also affected Malaysia. There was a severe devaluation of the Malaysian Ringgit. The crisis increased the level poverty, and exposed the vulnerability, stability and food security of Malaysia. The role of agriculture as provider of food and vital raw materials for the agro-based industries has become very significant. Malaysia like other countries of the world is experiencing structural changes in its economy and one of the prominent associated feature is the increasing importance of food production as a strategy to substitute imports and to increase exports. The government has realized that import substitution and attaining self-sufficiency in milk is difficult in the near future. Nevertheless, the DVS has been continuing to promote and support the nation's infant dairy industry in modernization and in improving the productivity of dairy cattle. It is considered that the country cannot depend on smallholders and traditional farmers to produce milk to meet with the demand for milk. There is a need to modernize, adopt high technologies for breeding and feeding of dairy cattle and to encourage large farms. Some of the important actions being initiated by the government are discussed.

The Third Agriculture Policy (DPN 3) has identified that agriculture be the third engine of growth behind industry and services. The strategic directions towards increasing efficiency and productivity and by intensifying private sector participation in livestock industry would be through:

- Private sector led contract farming for large-scale commercial production;
- Vertical and horizontal integration of all livestock sub-sectors;
- Smallholder to transform into large efficient commercial farm operations;
- The milk producers would be linked to suppliers, processors and marketing intermediaries to enhance the development of the industry;
- Encourage and promote specialized activities such as cattle breeding for commercial calf production, grow-out, and fattening for beef production;
- Private sector will be encouraged to increase the number of quality animals through breeding as well as imports;
- Encourage dairy processing enterprises to venture into upstream activities.

Developing Technology-based Industry: Private sector would be encouraged to adopt high technology including automation in intensive livestock production, processing, product storage, transportation and handling. To achieve this objective the private sector would be helped to:

- Invest in research and development and to collaborate with government institutions engaged in R&D work;
- Strengthen and develop new processes and products such as ready-to-eat, easy-to-prepare foods and health products;
- Identifying suitable replacements for imported feedstuffs from locally available agro-industrial by-products;
- Environmentally controlled intensive fodder production system.

Financial Environment: The government impetus for agriculture and food production is a renewed opportunity for investors. The government is playing a proactive role with incentives for investment in this sector. The states are providing assistance in acquiring land. Tax and financial incentives are being offered to investors in food agricultural projects. The industry would be supported by availability of local feedstuffs from agro based industry, strong institutional support by the department of veterinary services, milk collecting centers, refrigerated transportation and well established milk processing industry based on imported raw materials.

Competitor Environment and Market Growth: The growth in demand for dairy products in Malaysia is driven by the changes in dietary preferences, growth of quick service restaurants (particularly pizza and hamburger chains), and robust economic growth in the last two decades that resulted in increased urbanization and a growing middle-income society. In addition, increased awareness of the health benefits of drinking milk, along with rising disposable income and growth of food retail chains in Malaysia, which led to a greater availability of retail shelf space and a wider variety for dairy products have stimulated and increased consumption of dairy among Malaysians.

Establishing Designated Livestock Production Areas: State governments would designate specific areas for livestock production for (a) expanding livestock production to new areas in Sarawak and Sabah and (b) establishing designated disease free areas.

CONCLUSIONS

The demand trends of the milk and milk products market indicate a steady increase, and reasonably good potential for the future. It is therefore reasonable to expect the continued expansion of the dairy industry within the high value food industry sector, with increasing per capita consumption and consumer population growth. The recent financial crisis that occurred as a result of market liberalization devalued Malaysian Ringgit. This has affected the stability and security of the country's food supply. Though the dairy development program has successfully achieved its goal to reduce poverty and to stimulate dairy production activities in the smallholder, it has not achieved in increasing the total milk production and improving self-sufficiency. The future of the country milk production lies in large scale, technology driven modern farming production units and strategic use of feeds from the agro based industry.

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9. MONGOLIA

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INTRODUCTION

The dairy has been a key economic sector providing milk as a component of the Mongolian diet particularly in the rural areas. Milk is consumed directly and as traditional products, many of these being stored for consumption in the inclement winter and spring months.

During the command economy period, the Ministry of Food and Agriculture had set up large, intensive, mechanized dairy farms with the objective of providing dairy products to the urban population. The farms maintained black and white dairy cattle of *Holstein Friesian or Simmental* breeds imported from Russian and the former East Germany. The farms had facilities for artificial insemination and tried to synchronize breeding so as to produce maximum milk in winter months. The farms produced specialized fodder crops for feeding during inclement weather conditions. These farms proved to be non sustainable and the dairy cattle were distributed to other farms and to individuals. The recipients did not have adequate knowledge of management and were unable or unwilling to continue the breed improvement program as was expected at the time of distribution of cattle.

In 1992-93 DANIDA carried out a study of these large farms and concluded that the collapse of these farms was because of severe financial and management problems. The DANIDA agreed with the Ministry of Food and Agriculture to support a model to develop small, semi-intensive, family managed (cottage) dairy farms through a co-operation between the farmers and the milk processing plants. DANIDA supported farming experiment was started in 1994. A family unit comprised ten cows under relatively intensive management. Most progressive farmers were successful. The reasons for success of the DANIDA supported program were:

- Focused support on a specific sector;
- Addressing all the factors in the commercial milk production starting from the producer, through processors to the market;
- Payment of attractive price for the milk to the producer;
- Application of farming systems which were tested in Mongolia;
- Long-term technical support to a limited number of units;
- Investments were made from the resources of family farms;
- The promotion of the Dairy Farmers Association, as an NGO, to maintain and disseminate information on the sector and individual farmer initiatives. A recognition of the benefits of co-operation.

Consequent to the success of this program, the farms acted as very effective demonstration units for other farmers to copy and get voluntarily involved.

MILK PROCESSING

Mongolia does not have well developed infrastructure for milk collection and processing. The Municipal Corporation of Ulaanbaatar (capital of Mongolia) set up "Suu" company, with 51 percent

* Dr. Rattan Sagar Khanna is the editor of this publication but substantially contributed to the content of this paper, much more than usual editing.

shareholding. The plant of the "Suu" company has accumulated heavy losses and has not been paying its loans since the mid-1990s. Consequently, the company is unable to obtain new bank loans and working capital to renovate and re-equip the dairy. Most of the equipment is old and in a dilapidated condition and it has affected the performance of the dairy plant. The plant was therefore, handed over to new management. The situation has started improving but overdue loans of approximately Tg 1 billion, having been reduced from the previous Tg 1.4 billion, still remain to be paid. This plant has four collection centers and is by far the major purchaser of raw milk from farmers. At the summer peak, the daily raw milk intake is some 35,000 liters, which is very small for a city of this size of Ulaanbaatar.

The New Zealand Foods has set up a modern dairy plant with facilities for UHT plant and tetra packaging. The plant does not purchase milk produced by local farmers because of the quality of raw milk reaching Ulaanbaatar is considered to be unreliable. The New Zealand Foods recombines milk powder imported from New Zealand. The plant also packs fruit juice from imported juice concentrate. One dairy enterprise, GUM, which was originally established with financial support from DANIDA, has invested in a new building but does not have enough finances to upgrade and expand the processing line. The company is negotiating with international finance organizations for loans.

MILK MARKETING AND IMPORTS

The raw milk production and availability in Mongolia has wide seasonal fluctuations. Supply of milk is greater than the demand during summer months and the producers do not get good price for milk. The sale of unprocessed milk dominates the market in summer. In winter and spring seasons milk production is far lower than the actual demand.

The price of milk paid to the producer changes according to demand and availability. There is free negotiation between the producers and processors. The price of milk delivered to the processor, ranges between Tg 220 per liter, or less, during the summer when milk production is the highest and Tg 270, to as high as Tg 500, per liter during late winter and spring.

The sale of unprocessed milk in the city center is illegal. The producers and middlemen practice clandestine sale of raw milk in the areas relatively far from the city center in such prominent locations such as the railway station and some bus routes. There is a significant supply of milk to urban residents by so-called relatives and friends who own cows and live close to the city. This is because the prices of processed and packaged milk and dairy products are higher than the raw milk.

The market for processed milk and dairy products in Ulaanbaatar is highly seasonal. The main demand is in the winter and spring, when production from most farms is the lowest. To meet with high demand of milk, import of long life (UHT) milk and other dairy products from Russia is increasing. The most recent national statistics show imports of some 5,600 tons, which has more than doubled over the last three years (Table 1). Using the reasonable assumption that at least 60 ton of the imported UHT milk is consumed in Ulaanbaatar during the five months of winter and spring would produce a daily sales estimate of a little more than 20 tons. There has been a substantial fall in demand of milk since the 1980s. The main reasons are believed to be higher prices and a tendency amongst the youth to consume less dairy products and more vegetables.

Table 1. Import of Dairy Products to Mongolia between 2000 and 2002

Product	2000		2001		2002	
	Tons	US$ '000	Tons	US$ '000	Tons	US$ '000
UHT Milk	2,323	542	4,420	1,280	5,770	2,022
Condensed Milk	708	568	1,875	2,271	1,877	1,289
Milk Powder	346	1,385	1,385	1,958	835	773
Yogurt	130	111	293	311	467	527
Butter	55	65	62	79	19	48
Cheese, quark	11	32	160	34	19	41

Source: Food security Program

CHALLENGES AND OPPORTUNITIES

Concerned at the increase in import of dairy products, the government launched a 'Special Program for Food Security'. As a part of this program, a "White revolution" project is being implemented to 'increase the supply of dairy foods in Mongolia by reducing postharvest losses and restocking'. Thus far, the resources allocated by the government have been limited and the impact has been insignificant. The challenges and opportunities in dairy sector development in Mongolia are discussed below.

Challenges

Developing dairy industry in Mongolia is a challenge. There are not enough dairy cattle. Their prices are high and small farmers cannot afford to purchase. Milk production during summer months is high and the prices paid for milk to the farmers are low. The farmers do not have adequate knowledge of modern practices of breeding, feeding and healthcare. The pastures for grazing have deteriorated because of unrestricted access to a large number of animals than a pasture can provide. Pastures are not properly irrigated during summer because of shortage of water.

A small dairy farmer preferred to sell his cows and followers to establish a small trading business. For the time and effort made, returns from trading were higher compared those from rearing cattle. Banks are reluctant to provide loans for purchase of cattle and the interest rates on loans is very high. The milk producers do not have any access to any market for selling milk except those living in the periurban areas. Milk from the producers in rural areas is purchased only in the morning and transported daily and during winter on alternate days. The producers tend to sell milk of the evening by adding to the morning milk. The farmers store milk by traditional method of placing milk cans (churns) in wells.

There is serious deficiency in testing for quality of milk both from producers and consumers point of view. The processors do not have well equipped milk-testing facilities. The raw milk produced in Mongolia has high microbial load and is considered unfit for producing UHT milk. Testing of milk is done to check for milk fat. Producers are not paid any incentive for higher fat and non-fat content. Milk with fat lower than 3.2 percent is, however, rejected.

In Ulaanbaatar, clandestine sale of unprocessed milk dominates the market, particularly in summer. The milk producers have to negotiate price for milk with the processors. The producer gets the price for the milk delivered to processor between Tg 220 per liter or less during the summer flush and the price increases to Tg 500 per liter during late winter and spring during the lean production season. This induces farmers and consumers to sell/buy "fresh" milk. Both the farmer and the consumer gain because the middleman is avoided and also because the processed-packaged milk is very expensive.

Seasonality of milk production has put in a constraint on domestic operators because they require large working capital during flush season to purchase all the milk and convert it into milk powder to be used for balancing during winter when milk production is lower and the demand is higher than availability. Similarly, the farmers need to invest storing feed and fodder for winter and spring. There is a serious consideration to synchronize the calving of animals to increase milk production during winter and spring.

The dairy processing sub sector is not well developed. The "Suu" is the oldest dairy with 51 percent shares held by the Ulaanbaatar municipal committee. The building and machineries of the dairy plant are in a run down condition. The dairy has four collection centers and is a major purchaser of raw milk from farmers. Even at its peak the dairy processes 35,000 liters of milk daily including fresh milk and recombined from milk powder. Another dairy enterprise, GUM, established with financial support from DANIDA also requires funds for renovation of buildings upgrade of processing line. The company is negotiating with international finance organizations for funds. The only significant modern processing plant recently established by the New Zealand Foods has a UHT plant to produce recombined sterilized milk from milk powder imported from New Zealand. To support dairy operations, the plant packages fruit juice from imported concentrate.

Application of 'value added tax' (VAT) is a disincentive for milk production in Mongolia and has favored imports. The farmers producing raw milk are not registered for VAT. Therefore, the dairy plant purchasing milk from the farmers for processing has to pay full VAT on products, which effectively becomes a tax on total turn over. As against this the importers of finished products either do not

pay tax or pay VAT only on the value added locally which is far lower. Also, the VAT charged on the selling price of packaged pasteurized milk makes it more expensive compared to raw milk sold in loose condition. Despite the government having banned sale of unprocessed milk, the consumer prefers to buy unprocessed milk. Loose milk is illegally sold away from the city center but close to major transport routes, such as the main railway station. Milk is sold clandestinely to urban residents by vendors faking as 'relatives owning cows'.

Since the 1980s the demand for milk has been declining because of increase in prices of dairy products, tendency amongst the youth is to reduce consumption of dairy products. Youth are inclining towards vegetarianism and avoiding animal products including milk.

Opportunities

Great Hural of Mongolia declared policy for development of food and agriculture (Anon, 2003a). The government would create legal framework and economic conditions for sustainable growth of livestock. The methods and practice of herders will change and the first steps towards overcoming the climatic disasters will be taken. The preparations for improvement of the breeds and health of the livestock will be undertaken; the beginnings of rehabilitation of intensified livestock production will be initiated and model farms will be established around settlements. Government is planning to create facilities to settle at least 20 percent of herders in permanent and semi permanent settlements with rational use of pastures and rear the livestock on intensified feeding pattern. So as to sustain growth in dairy and milk production beginning would be made to develop intensified livestock production. To support this, conditions would be created to conserve fodder produced in the gobi desert and the steppe zones. Some of these settlements would be around cities so that there is ready availability of market for the milk produced. The country will be listed as disease free area so as to increasing its competitiveness for exports in the international markets. The small and medium scale private enterprises in food production and processing would be encouraged to use technologies to increase production of high quality produce for export.

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10. NEPAL

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INTRODUCTION

Dairying is an integral part of agriculture in Nepal. Farmers have been rearing cows and buffaloes since the time immemorial for meeting their domestic consumption of milk and milk products and for using their dung to manure their agricultural fields. Milk was not sold as it was considered a holy commodity not for trade. The community of *Phaubanjars, Gwalas* etc, produced milk for commercial purpose and sold milk in towns. The famous ***Juju Dhau*** (king of the curd), a delicacy prepared in Bhaktapur, some 100 years ago was sold in the urban areas of the Kathmandu Valley. Other milk sweets were marketed in the urban markets of Kathmandu, Nepalgunj, Janakpur, Birgunj, and Biratnagar etc. In the alpine areas, where *Nak/Chauri* milk was produced never sold it in the original form, they evolved a process to produce the traditional products such as *nauni* (butter), *sherghum, chhurpy* etc. Ghee has been a traditional product produced out of buffalo milk. It was an important source of cash for the farmers. Middlemen used to collect surplus ghee, bulk it and sold to the ghee merchants. The merchants after refining exported ghee to India.

The modernization of the society gradually eroded traditional beliefs and values of the people. Milk became a commercial commodity. Presently, the situation has completely changed and milk is produced purely for sale in the rural areas, having marketing facility. Income from the sales of milk is a regular source of income for majority of rural farmers. Until 1950, there was hardly any import of milk products to Nepal.

Nepal had no dairy processing industry until the later half of the last century. The first modern dairy equipment to be introduced in early 1940s by an enterprising family of Lalitpur was a hand operated cream separator. It was used to separate cream from milk for sale to some hotels and restaurants in Kathmandu.

AGRICULTURE, DAIRY SECTOR AND THE RURAL ECONOMY

Nepal ranks among the poorest nations in the world with a per capita Gross Domestic Product (GDP) of around US$250. Reducing the poverty is a major development challenge for the government. Of the total population of about 23 million, around 38 percent lives below the poverty line. This ratio has not changed significantly despite the implementation of nine development plans. Some of the causes for this situation are: the poor development indices, e.g., high population growth of 2.24 percent per annum; low literacy rate of 54 percent; skewed income distribution in terms of geographical, social and gender terms; the disadvantaged geopolitical situation, e.g., land locked country with large mountainous terrain, low land-man ratio, predominantly subsistent agricultural economy, lack of basic infrastructure, chronically minuscule non-government sector. Of the total population, 85 percent live in villages, and 81 percent are dependent on subsistent agriculture.

Agriculture is the largest sector contributing about 38 percent of the GDP. Livestock sector contributes about 66 percent to the agriculture GDP and 4 percent to national exports. Dairy sector contributes about 66 percent to the livestock sub-sector. The growth rate, in national milk production over the last decade averaged about 2.6 percent per year. Contribution of the dairy industry is estimated at NR 8-10 billion per annum (approximately US$107-133 million). The dairy sector has a vast potential

for development. The varied climate, good soil, sufficient irrigation, increasing productivity and a large market in neighboring India are positive contributors.

There has been no major improvement in crop productivity even though it has been a priority in all the national budgets. The distribution of land is such that the number of small and/or marginal farmers and landless dominate. Their resources are very meager and most of the households are heavily indebted. A major reason for slow growth of the economy has been the top-down approach in the preparation of the development plans; little involvement in the implementation of the plan by the local governments, the beneficiaries, the civic society or the development partners; lack of societal ownership of the plan; and lack of internalization of the lessons learnt in the past.

Livestock keeping is a part of rural life in Nepal. Livestock provide milk and meat, draft power for cropping and transportation, manure for replenishing soil nutrients, power for cooking. Livestock is a capital for a rural household to be converted to cash in emergency needs. The dairy sector has been playing a major role in securing social justice amongst the rural poor by providing off farm opportunities for increased employment and income generation. It was estimated that in 2002-03 the Dairy Development Corporation (DDC) paid NR 1,440 million, NR 3.94 million daily, to 150,000 rural farmers. Though the estimate of amounts paid by the private sector dairies is not available, the transfer of urban money to the rural areas is very significant.

Nepal has a very high population of cows and buffaloes, but the total milk production is very low (Table 1). Of the total milk production about 70 percent is buffalo milk and 30 percent is cow milk. About 10 percent of the national milk production enters into the organized dairy market. It is likely to increase as the road network increasing at the rate of 200 km/year further develops. It is expected that every additional kilometer road can add 39 tons of rural milk to the urban markets. In Nepal milk production has lean and flush seasons of milk production. This variation occurs due to seasonal calving by the buffaloes and better availability of fodder to milking animals during the monsoons and cooler weather conditions. The gap in milk production causes over supply during flush and scarcity during the lean.

Table 1. Population of Cows, Buffaloes and Milk Production in Nepal

Species	Total Number (Million)	Milking Animal (Million)	Percent of Total (Percent)	Milk Production (Million tons)	Average MilkProduction/ Animal (Liter per annum)	(Liter per day)
Cow	6.97	0.87	12.5	0.36	415.6	1.14
Buffalo	3.84	0.99	25.8	0.83	844.1	2.31
Total	10.81	1.86	17.2	1.19	643.4	1.76

MILK AND MILK PRODUCTS MARKET

Of an estimated 1.20 million tons of milk produced annually, 65 percent is retained in the household, 20 percent is sold through unorganized rural and urban sector and 15 percent is processed in the organized public and private sector. About 300,000 liters are sold daily in Kathmandu as liquid milk. A small portion is converted into products and the balance finds its way into the liquid milk markets of Biratnagar, Pokhara, Hetauda, Lumbini, Kohalpur ands other towns.

During 2000 it was found that the liquid milk market of Kathmandu was largely for toned-homogenized milk because of its use in making tea and coffee. Eleven brands of liquid milk were marketed in Kathmandu in polypacks. Consumers reported preference for DDC milk because of their confidence in this government-owned dairy. Other brands include “Today”, “Sitaram” and “Krishna”, “Anmol”, “Bhaktapur”, “Sainju”, “Kirtipur”, “Adhunik”, “Mahadev”, “Puspa” and “Shakti”. All liquid milk is sold as “cow’s milk” and there is a premium for “fresh” milk.

Brand	LPD	Market Share
DDC	125,000	42 percent
Today	35,000	12 percent
Sitaram	25,000	8 percent
Other brands	50,000	16 percent
Loose Milk	50-70,000	22 percent

The DDC is a major manufacturer of products for domestic consumption. Institutional sales account for some 80 percent of SMP and 50 percent of butter and cheese sales. Major institutional buyers are 210 hotels, 220 trekking agents, and the military and paramilitary forces. Mainly the public and private dairies to raise SNF content of liquid milk use the milk powders. Other users of milk powders were ice cream manufacturers, bakeries, confectioneries, and the military and paramilitary force. The institutions are conscious of quality as well as of price. Hotels and restaurants want packaging convenient to their volumes of sales; trekking agencies prefer consumer packs.

Nepal's ice cream market is small and concentrated in Kathmandu. Estimated sales were NR 36 million. The largest brands are Kwality, Vadilal and DDC. Cheese production and consumption is largely found in the hills and mountains. Yak milk cheese is the major product. DDC does have facilities to produce cheese from Yak, Chauri, Cow and Buffalo milk and, during 1997-98 manufactured approximately 175 tons.

Market for the dairy products is dominated by imports. Kathmandu has some 200 importers sourcing mainly from India and some from other countries. To Nepal imports can be made without any license, against an open letter of credit (FNCCI, 1999). The Central Food Research Laboratory, Kathmandu conducts quality checks and against their certificate import can be affected.

SECTORAL DEVELOPMENTS IN DAIRY

Public Sector

Organized dairy development activities in Nepal began in 1952 with the establishment of a Yak cheese factory in Langtang of Rasuwa district with FAO assistance. In 1954, the Department of Agriculture set up a dairy development section and a small-scale milk processing plant in Tusal village in Kavre district. In 1956, a Central Dairy Plant, with milk processing capacity of 500 liters per hour was established in Lainchaur, with the financial assistance from New Zealand and technical assistance from FAO. Another mini milk processing plant was established at Kharipati, in Bhaktapur district in 1958. In the process, prior to 1960, two additional cheese factories were established in alpine districts.

As the milk processing increased the government set up a Dairy Development Board which in 1969 was incorporated under the Corporation Act 1964 as the Dairy Development Corporation (DDC) for carrying out dairy development activities. The DDC established Milk Supply Schemes in various parts of Nepal to meet the growing demand for processed milk and milk products. In 1989, with DANIDA assistance, DDC processing capacity was increased to 220,000 liters per day.

A 10-Year Dairy Development Plan (1990-2000) was prepared with assistance of Royal Danish Government. Based on the recommendation of the plan, HMG/N established in 1992, National Dairy Development Board (NDDB) as an autonomous national policy-making body for dairy development. NDDB has been facilitating research, training, entrepreneurship development, and providing technical assistance to the milk producers, dairy cooperatives, public and private dairies, NGOs and social institutions. Recently the NDDB has supported farmers' cooperative to establish three small-scale and one medium-scale dairies.

Cooperative Sector

In 1981 the DDC initiated and assisted milk producers to form their own Milk Producers' Associations (MPAs) on the lines of AMUL village dairy co-operatives in India. The DDC provided technical input services and financial help to the farmers through these associations. The MPAs functioned as single purpose for milk trade and production. It was experienced that MPAs enabled the producers to solve their problems with assistance from the DDC. In 1989 the MPAs were formalized as co-operatives. The main function of these MPCs was to collect milk from the farmers, both members and non-members, test it for quality, transport and sell to the nearest milk chilling center or the processing plant of the DDC and/or a private dairy; receive and distribute payment to the individual milk supplier farmers. Some of the MPCs have also started vale added activities, e.g., milk chilling vats; making dairy products; selling cattle feed and veterinary drugs; grocery items to meet the daily needs of the farmers.

The MPCs in different districts have formed District Milk Producers' Cooperative Unions (DMPCUs), under Cooperative Act. The main objectives of the DMPCUs are to deliver inputs to increase milk production and process milk into milk products so as to contribute to the financial and

social upliftment of milk producers. In 1993, the MPCs and DMPCUs have federated into a Central Milk Producers' Cooperative Union (CMPCU), a national-level cooperative. The main objectives of the CMPCU are to implement programs in support of milk production and processing; and to contribute to the financial and social advancement of milk producers.

In 2004, there were 1,329 MPCs in 41 districts and 38 DMPCUs. Despite a massive co-operative network at primary, district and at national level, there is near absence of any business of milk chilling or processing by them. Only a few MPCs and DMPCUs are managing small-scale dairies.

Private Sector

The private sector started getting involved in the dairy-processing sector from late 1970s with very small-scale operations in Kathmandu. During 2004, there were about 135 private dairies, including cooperatives, of various sizes both within and outside the Kathmandu valley. The private entrepreneurs have set up facilities in the mid and high mountain regions for producing cheese from cow and *nak* milk.

The private dairy entrepreneurs organized into the "Nepal Dairy Association" (NDA) in 1998. The NDA has 98 small, medium, and large-scale member dairy industries. The main objectives of the NDA are to work for common good of the dairies in Nepal, and make technical support available to its members. Its commitments are to support dairies for their professional development, explore new technologies, and transfer them to its members.

Inter-Sectoral Partnership

During 2004 total milk processing capacity was around 600,000 liters per day, 200,000 liters per day in the public and 400,000 liters per day in the private and cooperative sectors. It is estimated that the private sector utilized 50 percent of its installed capacity because of tough competition among the private industries and the established goodwill of the milk and milk products from the public sector DDC. Nevertheless, share of the private sector in the milk market has been increasing steadily with an overall annual growth of 15 percent. To encourage and build up the private and the cooperative sector NDDB has initiated public-private-partnership program.

FUTURE OF DAIRY SECTOR

Nepal has adopted an agriculture led economic growth and poverty alleviation strategy by implementing a 20-year Agriculture Perspective Plan (APP). The APP has targeted an annual growth rate of 5 percent in agriculture and 5.5 percent in livestock sector, and 5.5 percent in the dairy sector for the next ten years. In the Tenth Plan (2002-2007) period, HMG/Nepal has an ambitious target to raise the milk production by 20 percent from 1,196,000 tons in 2001/2002 to 1,400,000 tons by 2007 thereby raising the per capita availability of milk to 51 liter per year.

Globalization of the trade through large multinationals is increasing the competition in the dairy industry for marketing of milk and milk products. Some developed countries with large-scale dairy processing and products are exporting products at much lower cost as compared to the developing countries. The dairy sector in the developed countries is supported through export and production subsidies. Nepal is preparing to enter World Trade Organization (WTO) and South Asian Free Trade Agreement (SAFTA). In Nepal import duty is very low at around 15 percent on milk products and there is no duty on import of fluid milk. From 2004 the government has abolished the export fee of 0.5 percent. The import tariffs in the countries neighboring Nepal are much higher. India has given special concession and levies no duty on dairy products exported from Nepal. In Nepal therefore the dairy products market is threatened from cheaper imports and it may hurt the nascent and infant dairy industry of Nepal. There is a need to restructure national policy to develop and nurse the Nepal dairy sector. The HMG/N should develop a regional policy with neighboring nations and with other countries.

Imported milk products are mainly milk powder (MP) and condensed milk. DDC produces about 600 tons of MP/year. National import of MP is about 6,000 tons/year. Exports from Nepal are mainly ghee (about 900 tons/year) and some Yak cheese through informal channel.

CHALLENGES AND ISSUES

The major challenges constraining the growth of dairy sector in Nepal are poor genetic quality of cattle and buffalo breeds; poor fertility and calving delays, low productivity, scarcity of feed and fodder, lack of skilled manpower, inactive farmers' cooperatives, poor quality of milk produced in the rural areas, wide seasonal variations in milk production with the dominance of buffalo milk, lack of milk conservation facility, etc. Higher production of milk during flush season creates problems of handling and reduction in the "Milk Holiday" by not buying milk on predetermined days. The rural road network that can facilitate collection and transportation of milk and give access to the urban markets is very poor and inadequate.

Since public sector is dominant in the dairy sector, there is need to expand its processing capacity. For the last 13 years the DDC has not added to its existing milk-processing capacity. The farmers' cooperatives do not have any milk processing capacity. They have suffered from lack of financial resources, technically qualified manpower and managerial capability. Large private industrialists have not ventured into dairying in a big way. Most of the private dairy sector is small and financially weak and have been shy of investing in facilities for production of milk powder.

Except for the DDC that has added some processed milk products to its portfolio, most of the dairy sector is focusing on selling only fluid milk. Absence of product diversification is due to lack of resources, lack of knowledge about dairy products and technology to produce them, poor quality of raw milk, and complete absence of research and development support for market research, market intelligence, product knowledge, consumer preferences and product development.

Lack of development of the dairy industry in Nepal is also because of the uncontrolled use of milk powder. On an average Nepal imports some 6,000 tons of milk powder every year. Milk powder is utilized to balance the seasonal variation in milk production. During the period between March and August, milk production is lower than the demand for milk. Similarly there is spurt in the demand of milk festival times, and the sudden road blockages and strikes. The dairies find it easy to use milk powder rather than incurring heavy expenses in purchasing and transporting milk from the rural areas.

The quality of raw milk produced by the rural farmers is very poor. There is lack of knowledge of practices for clean and hygienic milk production. Animals are not properly cleaned while milking; the utensils used for milking and storing milk are of poor quality metal and construction. Poor road infrastructure adds to the transportation time of milk particularly in the hills and thus increases the bacterial load by the time the milk arrives the dairy dock. The Terai region has tropical ambient temperature and in the absence of refrigerated transport facilities affects the quality of milk. Quality of milk is also affected by malpractices for adulteration of milk by addition of water for increasing volume; sodium bicarbonate for reducing acidity, starch and sugar for increasing solid content, etc.

Nepal does not have facilities for training and creating skilled manpower both at the higher levels and the middle levels. While the public sector gets its people trained from neighboring India, the private sector dairy industry is both shy of investing in trained manpower as well as getting them trained.

The domestic dairy industry has made almost no investment in market promotion activities. Consequently, the market for dairy products is neither developed nor expanding. Consumer is not aware of the requirements of quality of milk and milk products being consumed or that ought to be consumed. Consumption of milk not related to health requirements and is used primarily for tea.

OPPORTUNITIES AND EXPECTATIONS

Analyzing the constraints, NDDB has prepared a national dairy policy, which is under consideration of the HMG/N for approval. The policy focuses on the measures to: reduce cost of milk production and make milk price competitive, encourage for increasing the farm size for commercialization of milk production, introduce technological interventions for seasonality breaking, low cost feeding along with upgrading for genetic improvement of indigenous stocks, quality improvement, manpower development, market promotion and institutional development.

Strengthening the Farmers' Cooperatives: The policy has identified the areas for development of skills for the farmers and the co-operatives would be strengthened to imparting the knowledge

for low cost milk production. They would provide technical support for milk collection, testing and chilling, launch programs in the rural areas to make the farmers aware of the importance of good quality of milk; hygienic milk production, the health hazards caused by adulteration of milk, and safe transportation of milk.

Quality Improvement: To improve the quality of raw milk, it is suggested that raw milk should be purchased on protein and fat content of milk instead of the existing fat and solid-not fat based system. This would discourage adulteration National standards of dairy products should be revised in accordance with the international standards within five years. There is need to apply stringent quality control measures in milk processing, production and distribution of milk and milk products. The standards should be legalized and continuously monitored. Legal actions should be taken against those that fail to meet with the standards.

National Milk Grid: The policy has identified need for developing National Milk Grid. The NMG would identify the surplus and deficit milk production zones and seasons. This would devise approach for improving the milk quality and reducing seasonal variations in milk production and consumption. As a part of NMG and to balance the variation in milk production and availability, new milk processing plants including powder milk plant and cheese factories would be established.

Market and Product Development: Technical support should be provided by analyzing the comparative advantage of various milk products and for product diversification of high quality of modern and traditional milk products and by exploring new domestic markets of milk and milk products. It is proposed to encourage small dairy processors, located particularly outside the big urban areas, in production of traditional milk products; and training them in quality improvement programs and manufacture of milk and milk products that are safe, pure and healthy. So as to inculcate the advantages of milk as a source of good nutrition it is proposed to implement "school milk program" amongst the school children.

Dairy Product Export Development: The policy has proposed for providing market information about potential markets for export of milk and milk products by conducting regular studies about the product types, quality standards, demand supply, prices, market channels, etc. in the neighboring countries and disseminate these information to the producers of milk and milk products. It is necessary to carry out studies on factors to reduce the cost of milk processing and production of exportable milk products.

Manpower Development: The middle and lower level technicians should be provided with adequate training within the national institutes. Similarly, staff in management, finance and marketing should be trained in the national institutes, and fresh manpower in these faculties should be hired from the market. Scholarship in India or abroad should be arranged for the higher-level manpower like B.Sc. and M. Sc. in Dairy Technology. Expenses incurred by the dairy industry in research and development and on training and education should be exempted from payment of income tax.

Policy Developments: There is need to continuously monitor the dairy sector and its developments at the national and international levels. The NDDB would analyze the major issues such as non-tariff trade barrier in the SAARC countries, produce fact-finding reports and disseminate it to the decision makers. It would assess the requirement of various types of manpower requirements and developments for the dairy sector and for conducting studies on various aspects of dairy sector and disseminate the findings to the policy makers, dairy farmers and dairy entrepreneurs.

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11. PAKISTAN (1)

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INTRODUCTION

In Pakistan, agriculture is the largest sector of the economy contributing 25 percent to the GDP and employing 51 percent of the labor force. Over 60 percent of the population lives in rural areas where the quality of life has lagged behind the urban areas. Dairy and livestock contribute 43 percent to the agricultural GDP, which is more than the 38 percent combined contribution by three major crops. It is said that if it were not the livestock sector the rural impoverishment would have wiped out the small farmers and rural landless masses. Despite its importance to the agric economy, the livestock rearing has remained a subsistence activity. Milk is the largest product of livestock sector accounting for 58 percent of the total value of livestock produce. Smallholders accounted for 80 percent of the marketed milk. For them income from livestock is secondary. For the peri-urban milk producer it is a purely commercial activity. Only 20-25 percent of the total milk output is channeled into urban marketing system.

Of the total 28.3 million tons of milk produced in Pakistan, about 66 percent is from buffaloes, 32 percent from cows and 2 per cent from goats and sheep. According to FAO (1997), the buffaloes are "Black Gold of Asia" with average lactation yield of 1,800 to 2,500 liters, while a few specimens can produce up to 6,000 liters. Despite availability of good genetic material, most animals in Pakistan are poor milk producers mainly due to poor management, inadequate nutrition, high mortality and morbidity caused by tropical diseases and inappropriate marketing of milk, a highly perishable commodity.

Absence of organized sector and transport infrastructure has made rural production of milk an unattractive and financially unviable activity. In urban and peri-urban areas, the cost of milk production is much higher than in rural areas. Under the existing traditional technology of milk collection and distribution, urban and peri-urban production is the only financially viable system for milk production.

Milk and milk products are traditional and an integral part of diet in Pakistan. Among the livestock products, milk is important and extensively consumed. It contains all the essential nutrients in a highly digestible form. Unfortunately, milk consumption in Pakistan is not up to a desirable level compared to developed countries and a number of developing countries.

FARMING SYSTEMS

Traditionally, about 5-6 million rural households keep cattle for draft power for farming and milk for family consumption and for sale. About 2.5 million smallholders keep around 55 percent of the indigenous cattle population. Of these 60 percent are in Punjab, 20 percent in Sindh and 14 percent in North-West Frontier Province (NWFP). Increasing use of tractor power has shifted the need for keeping animals for draft to production of milk and beef. Various farming systems in practice in Pakistan are discussed below.

Irrigated Areas: In irrigated areas, farmers rear indigenous non-descript and pure breeds of cattle for milk. Cattle are generally grazed along the riverbanks. Their feed comprises 25 percent wheat/rice straws, 60 percent cut fodder and less than 10 percent purchased concentrates. With current yields of fodder crops, these cattle units require fodder production from about 0.7 ha of land.

Rainfed *(barani)* **Areas:** In *barani* areas average farm size is five cattle heads kept primarily for draft. Keeping buffalo is less common. About 50 percent of feed is by-products of cereals, crop

* Dr. Muhammad Anwar was not a selected participant but voluntarily presented this country paper "Pakistan (1)" on behalf of the University of Agriculture Faisalabad, one of the project implementing organizations. He also attended the project for entire duration.

stubble, straw and grazing on wasteland and community pastures. Remainder of the feed is from cut green fodder and a small amount of concentrates. Land required for fodder production is about 0.14 ha.

Smallholder Rural Milk Production: Almost 80 percent of milk supply is derived from about 5.4 million mixed crop-livestock units mostly in irrigated areas. They keep buffaloes for milk production and indigenous cattle for draft purpose. Access to milk markets, determines whether the farming is market-oriented or a family-subsistence. An average **Market-Oriented Smallholder** farm consists of five buffalo heads: three buffaloes in milk and two female followers and occasionally a male calf but rarely any adult male. Such a smallholder would devote 10-20 percent of cultivable land for forage crops so as to provide total feed requirements from this source. Some landless farmers also practice this method by purchasing fodders, straws and feeds. **Subsistence Smallholder,** with no access to the milk market, produces milk for family requirements. About 70 percent of smallholder milk producers fall into this category. An average subsistence unit consists of about three buffalo, including two adult females. Of the total feed requirement, 50-60 percent is met form grazing, home grown straws, 25 percent from cut green grasses, and 10-15 percent from purchased concentrates. They incur minimal expenses on feed or labor but may allocate non-cash resources of land. If there is arrangement for purchase of milk such farmers sell surplus liquid milk. Family consumption tends to decline. Management and feeding of animals is improved by giving green fodder and purchased concentrates. As a result of better management and nutrition, milk yield increases, calving interval decreases and percentage of productive animals increases.

Peri-Urban Milk Production: A century-old system, peri-urban farms or buffalo/cattle colonies, has grown in recent times in response to increasing prices and demand for milk in the metros and large cities. Development of motorized road transport around the large cities and towns has helped these farms in creation of an effective input supply network. Sindh province has many large herds ranging from 10-200 head (average 50). An example of such a large commercial unit is the landhi cattle colony near Karachi. The farmers keep 90 percent buffaloes, of which 95 percent are in milk. The lactation lasts for 250-300 days and the dry animals are sold for slaughter. About 50 percent buffaloes are returned to the rural areas for pregnancy and calving. Farms purchase high yielding female buffaloes in third or fourth lactation close to calving or with calf at foot. Because of the high value of milk, calves remain with their mothers for only four to seven days and are sold for slaughter. In the absence of the calf, letdown of milk is forced through injection of oxytocin. These are high-investment high-return commercial units. They invest in a yard or hire it. Major expenses are on labor hired at rates in urban areas, on veterinary medicines, electricity and water charges, and milk transport. They deliver milk to market twice a day. Apart form the earning from milk sale of farmyard manure is another source.

Rural Commercial Milk Production: The emergence of a new rural-based commercial category of dairy farm is a recent phenomenon. Although very important as a future vehicle for extending improved production techniques, the number of producers in this category is <1000 and their contribution to total milk supply is small. The typical unit comprises 90 percent buffalo and 10 percent cattle – about 40 buffalo of which 60 percent are adult females producing milk. These production units may be part of a larger mixed crop-livestock farm or a specialized farm for milk production. Fodder crops provide more than 50 percent of total feed; straw, either home grown or purchased, provides about 35 percent and the remainder is purchased concentrates. In locations with rivers, rain or waterlogged areas, grazing is used as a substitute for straw and greens.

Progressive Farmers: A few progressive farmers are setting up large mixed crop-livestock farms. They keep high yielding buffaloes and Friesian crossbreds for commercial milk production. They use modern technology for cultivation, prepare and feed balanced rations and using frozen semen and artificial insemination for breeding. Most of these farms have tie up with large dairies for supply of milk. There are very few such farms but this system could become model for the future.

DAIRY SECTOR ISSUES

Animal Breeds and Breeding: Genetic potential of the breeds is the major hurdle to higher milk yields. Local breeds are known more for their tolerance to heat and resistance to diseases than for their efficiency of converting feed to milk and meat. Over the years, the indigenous breeds have been diluted by imported semen to produce crossbred animals. The fragmented livestock ownership, lack of

rural infrastructure, lack of commercial orientation, inadequate healthcare and insemination services, have hampered directed breeding for improving the productivity of animals.

Animal Feeds and Feeding: Rearing of livestock is dependent upon whether the rural families are landlords, sharecroppers or landless. Farmers with irrigated land feed green fodder mainly berseem in winter, sorghum and maize in summer. Wheat straw, rice straw other agricultural and agric-industrial by-products are fed to all animals. Dry animals and young calves are exclusively grazed on wasteland or crop stubble. Grazing is of economic importance along the riverbanks. It is estimated that 10-20 percent of the land is devoted for cultivation of fodder crops. Most of the fodder crops grown in Pakistan have low yield and are a poor source of nutrients. It is estimate that the livestock in Pakistan is given 20-25 percent lesser feed and nutrients than the requirement to produce up to their genetic potential.

Subsistence Farming: Smallholder focuses more on risk minimization than commercial productivity. Therefore the smallholder finds it safer to keep local breeds than high-risk imported breed of animals for milk production. The type of low-investment low-return economy of livestock keeping is based on reducing the cost of labor, feeding and by keeping small herd size of 5 to 9 animals. The family labor manages all the animals. This is the reason that in Pakistan, 63 percent of the milk producers have an average herd size of 2 cows/buffaloes.

Inefficient Milk Collection and Distribution System: Milk production is the least commercialized activity in the agricultural economy. Milk collection and distribution for the urban areas, although very commercial, is almost entirely handled by the informal sector. Organized collection, processing and marketing of milk represent hardly 2 percent of the total urban milk market.

EXPLOITING DAIRY POTENTIAL

The dairy sector has a wide gap for improvement in its yield potential as compared to the other crops. Compared to the best in the world average yield in Pakistan of cotton is 99 percent, wheat: 77 percent, Rice: 73 percent, sugarcane: 70 percent but from cattle only 23 percent. In Pakistan the average milk yield is 1,150 liters per lactation while in the developed countries, the average milk yields are 5,000 liters per lactation (Table 1). Improvement in milk production of dairy cattle and buffaloes can be achieved through better management, breeding, feeding, disease control and providing marketing infrastructure. There is a need to optimize the use of available fodder resources. Several studies have shown that farmers, operating near urban centers are economically efficient in management of the dairy stock and have higher financial earning per animal.

Table 1. Comparison of Yields of Major Crops and Milk in Pakistan and World

Particulars	Unit	Average Yield in Pakistan (A)	Average Yield in World (B)	Percent A/B
Cotton	Kg/Acre	671	678	99
Wheat	Kg/Acre	831	1,084	77
Rice	Kg/Acre	1,144	1,567	73
Sugarcane	Kg/Acre	17,629	25,247	70
Milk	Liters/Lact	1,150	5,000	23

LINEAR MODEL TO OPTIMIZE PRODUCTION SYSTEM

A linear programming model was studied using all resource constraints and coefficients to evaluate alternative scenarios as a potential decision-support tool. It was premised that best returns from mixed crop-animal farming system could be obtained with most efficient use of available resources. The study resulted in developing optimum production plans for farming system with a mixed crop and dairy enterprise as a source of income. Important findings of the study are discussed.

New Technology: The result showed that to improve farm productivity it was necessary to use improved seed, apply latest scientific methods of cultivation, and inputs to enhance the net income of the farmer. The adoption of improved technologies increased the net margins by increasing crop yield per hectare and per head productivity of dairy cow and buffaloes. Application of new technology

increased the net margin per day of labor by 114.49 percent. The financial performance per day of labor increased to 120.24 percent if necessary capital to buy inputs and dairy animals was made available to the farmer. Economic analysis of individual treatments showed that even by adopting one or two components of the improved production technology, farmers could improve his rate of return. In actual practice it was found that only a very small percentage of farmers were able to get high quality seed for cash crops and food crops; and the fertilizers were in short supply, when needed most, at the time of sowing as well as the first irrigation.

The principal factors inhibiting the uptake of the technology are (a) small herd size and poor economic status of farmers, (b) research is not carried out at the field level but at the institutional farms, (c) the infrastructure for transfer of technology to the farmers is almost non-existent. The existing infrastructure for animal husbandry development is essentially to provide breeding and health cover with little emphasis on reaching farmers and demonstrating to them the improved technologies and their advantages, (d) the state agencies implementing the development programs are over-burdened and inefficient to do justice to the vital needs of the farmers.

It is essential to train manpower to undertake on farm research, set up systems for transfer of technology, and establish linkage between the research institution and the user. The provincial livestock and dairy development departments, development agencies, and research institutions, agricultural universities need to develop in house capabilities to understand the problems in the field on which on-farm research should be carried out. These institutions should employ subject matter specialists to develop linkages between research and development and the training needs of farmers; should train the farmers; should transfer improved production technologies to the farmers; identify constraints, if any, in the process of transfer of technologies; and remove constraints in use of available technologies.

Mixed Farming Systems: The results of the ITC model showed that if cash and food crops alone were grown, the gross margin was reduced. The exclusion of dairy activities from the model decreased the net margin by 45.45 percent, even if improved technology was used to grow specialized cash crops. The farming system that combined cattle and buffalo for milk production with irrigated intensive cereal cropping and fodder production was more successful. There was a distinctive advantage where access to peri-urban milk market was available. The dairy production is an expanding feature in these situation in which it is integrated with crop cultivation and provides an economic motivation for farming system. In Pakistan wheat, rice cotton, sugarcane, maize, potatoes and berseem production is done with dairy buffalo and/cow production.

Management to Reduce Calving Interval: The small farmers generally do not pay serious attention to the breeding, feeding, disease control and general welfare of their buffaloes. Very long calving intervals are observed in Pakistan dairy buffaloes and cows. Short calving interval is recommended for maximizing profitability. The results of the model showed that the net margin to farmers could be increased up to 62.10 percent by reducing the calving interval from the existing 18 months to 14 months. The financial performance in terms of net margin per day of labor was further improved to around 180.76 percent if improved technology was coupled with a short calving interval with out any major change in the cropping pattern. Dairy buffaloes have to be bred to conceive with 2 or 2.5 services. The reproductive efficiency and fertility in dairy animals are very much related to milk production efficiency.

Milk Yield: Compared to the maximum milk production potential of the herds maintained at research station or progressive livestock farms to the milk yield in the field, the gap is about 100 percent. The result from the model showed that with a 25 percent increase in milk yield in buffaloes net margin of the farmer could increase by 70-80 percent. The improved milk production coupled with improved technology in crop production increased the net margin by 196.58 percent. These factors are well recognized in general and have been extensively documented. However, the farmers have little formal education and limited knowledge of dairy husbandry. At least two to three months of intensive practical training is required to provide farmers with reasonable technical background in dairy farming.

Availability of Capital: Availability of capital is vital for investment and working capital. Investment required to purchase good quality dairy animals is very high and a large amount of working capital is required to manage a successful dairy business. Most smallholders have limited financial resources and depend on bank loan. The banks and credit agencies have a bias towards large farmers who have collateral to pledge, but the smaller and tenant farmers are left out (Khandker and Faruquee, 2001).

Conclusions: The models developed for farm planning should be seen as assistance in decision-making and not as hard and fast rules for making decisions. Ideally, such models should realistically represent farm systems, but as a matter of fact they are simplification of real world and results should be carefully analyzed rather than just replace them for any previous information. For example, it is very likely that farmers have their personal preferences for taking certain actions. If the results of the model suggest that the intended action is the best, then farmer may go ahead with more confidence. If intended action is not in agreement with the results, then farmer should spend more time reconsidering their choices and examine them more deeply. The conclusions drawn from the analysis of the factors affecting dairy production system in Pakistan are presented as follows:

1. The current dairy farming practices are unable to pay back the farmers' own labor.
2. At the current level of milk production dairy buffaloes are more profitable than dairy cows.
3. By improving technology to grow crops the net margin to the farmer can be increased by 114 percent.
4. The net margin can go up to 196 percent if improved technology is combined with improvement in milk production.
5. Short calving intervals in combination with improved technology increases the net margin to 180 percent.
6. Dairy farming is a capital-intensive and availability of credit to small dairy farmers is the key factor to buy input for improved technology and quality dairy animals.
7. Mixed crop-animal farming is more profitable than the specialized crops farming even if these are cash crops.
8. The net margin to the small dairy farmers can be increased many folds by increasing per acre crop yield, per animal milk yield, increasing reproductive efficiency, irrigation water, and using improved technology for crop production.

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12. PAKISTAN (2)

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INTRODUCTION

Since the Government of Pakistan is taking serious attention in developing the livestock and dairy sector, there is expectation. During 2004, Pakistan had nine dairy factories working in the private sector viz., Haleeb Foods Limited, Nestle Pakistan, Millac Foods (pvt.) Limited, Noon Pakistan Limited, Nirala Dairy (pvt.) Limited, Dairy Crest Foods, Prime Dairies, Idara-e- Kissan and Premier Dairy Limited. In the government sector there were two dairy factories managed by the Pakistan army. Two new companies KNK Dairy and Engro Dairy were trying to enter the dairy business. Of the total milk collected by these dairies 70 percent was by Haleeb and Nestle.

MILK COLLECTION

In Pakistan milk collection is undertaken by milk contractors, mini suppliers, *dodhies and gawalas,* village milk centers (VMCs), progressive dairy farmers and direct from small farmers. Each has their typical method of purchasing, collecting and selling or reselling milk. Their methodologies are described below.

Contractors: They have their own infrastructure in the villages and town where they collect milk from *dodhies* and mini suppliers and transport and supply milk to the dairy factories like Haleeb, Millac, Premier, Dairy Crest, etc. Some of the contractors have their own network of supplying loose milk to the consumers in big cities like Lahore.

Mini Suppliers: A mini supplier collects raw fresh milk from one or more than one locations. Except a few mini suppliers who have their own milk collection infrastructure, most of them are provided with collection infrastructure by the major dairy plants. They get commission on per liter of milk collected for the dairy company. Dairy companies announce price of milk for those locations. Farmers and *dodhies* supply milk at these locations.

Dodhies and Gawalas*: Dodhies and Gowalas* are the middleman who collects milk from actual producers in the rural areas. They visit door to door for milk collection. They fix their own terms of purchasing milk with each of the individual farmer. Price may vary from village to village and door to door. They pay very low price to poor farmers living in remote areas. During summer months when supply of milk is short they play and important role and charge very high price of milk to the dairy companies. They collect milk in cans made from galvanized iron or aluminum and transport milk to the collection point on motorcycle or bicycles.

Village Milk Collection Centers (VMC): This is very effective and successful milk collection system started by Idara-e-Kissan and followed by other dairies in the organized sector, e.g., Nestle and Haleeb. A farmer identified as 'agent' by Idara-e-Kissan (as also by other companies) is in-charge of collecting milk from the farmer-producers in a village at on point. The 'agent' has the responsibility to deliver milk to the dairy factory or to a point where the milk tanker of the dairy factory would collect milk at a given time. The Dairy Company decides the price of milk payable to the farmer-producers and the 'agent' is paid per liter commission for the quantity of milk collected and delivered. The village agent act as the communicator on behalf of the dairy factory for various information, price paid for milk and for provision of agric-services to the producers.

Progressive and Direct Farmers: To collect milk directly from the small farmers and from the progressive is more expansive than collecting milk through other media. But the milk obtained from the farmers is of a very good quality both in terms of fat and SNF content as well as the microbial load. This is a good means to win the confidence of the consumer market. At present Nestle, Idara-e-Kissan and Haleeb are collecting milk through this method.

MILK TRANSPORTATION

Raw milk has short shelf life and has a tendency to spoil very fast in the tropical weather condition prevalent in Pakistan. It has been estimated that around 30,000 liters of milk is spoiled every-day mainly because of non-availability of good milk collection system. Most of the dairy companies in Pakistan collect milk at a point and transport after adding ice as a means to 'preserve' and save milk from spoilage. Depending on the source of ice, milk has a tendency to carry more microbial load. It dilutes the milk, deteriorates its quality, reduces total solids contents, adds to cost of transportation as well as processing and drying milk to powder. An ideal module for milk collection and transportation for Pakistan would be as is shown the flow diagram (Figure 1). Considering the weather conditions in Pakistan milk collected from the farmer should be transported and reached within 5-6 hours of milking to a chiller and the temperature of milk brought down to 2-4^{o} C. The chilled milk should then be transported to the dairy factory.

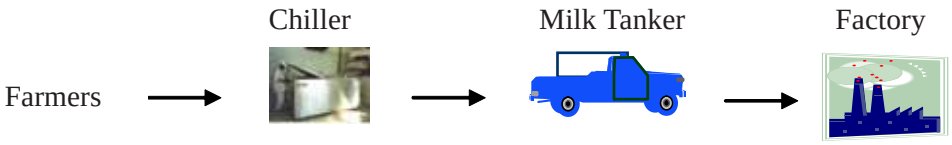

Figure 1. Ideal Milk Collection and Transport System for Pakistan

MILK PAYMENT SYSTEM

Most of the dairy companies pay in cash to the person supplying milk except Nestle and Haleeb who pay through bank transfer. On receipt of milk at its dock, the dairy factory issues a 'milk receipt note' or 'milk purchase receipt', a document required for reference at the time of payment. Milk is paid on the basis of quantity of its contents. The buffalo milk is paid for volume adjusted to 6 percent fat basis and the cow milk adjusted to 15 percent total solid basis. Price of milk in Pakistan varies in winter and summer depending upon demand and supply situation.

13. THE PHILIPPINES

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INTRODUCTION

Livestock population in the Philippines is 9 million but the population of dairy cattle and buffaloes is much less and their growth rate is slow (Table 1). Lately the farmers have taken interest in rearing dairy goats for milk production. The National Dairy Authority (NDA) in partnership with the local governments has been vigorously pursuing upgrading the local cattle through crossbreeding with dairy cattle imported from Australia and New Zealand. The Philippines Carabao Center has been given the responsibility of upgrading swamp buffaloes by crossbreeding with Indian breeds of water buffalo. Total production of milk in the Philippines was 11,000 tons in 2003.

Table 1. Livestock and Dairy in the Philippines in 2002 and 2003

Particulars	2003	2002
Total livestock population	9,195,230	9,007,017
Total dairy herd	22,861	22,734
Total dams and does	11,392	11,139
Number of farm families	8,750	8,000
Number of co-operatives	210	150

Source: Annual Reports of the NDA

SMALLHOLDER DEVELOPMENT AND DAIRY CO-OPERATIVES

To build up national dairy herd and increase milk production, the NDA identifies smallholder farmers and offers a module of three dairy cows. A dairy farmer-family is expected to maintain at least one or two milking cows throughout the year that would ensure regular income. This program of the NDA is expected to help the rural community as well as the dairy industry. It would generate rural employment and maximize the utilization of land resource and agric by-products; provide milk as food for the family thereby improving the nutritional condition. In the processing industry the program would generate investments from the private sector and help create job opportunities. The dairy co-operatives have accounted for at least 54 percent of the total domestic milk production in 2003 (Table 2).

Table 2. Performance of NDA Assisted Project Area

Performance Indicator	2003	2002	Percent growth
Herd inventory	9,893	7,818	27
Milk production (Tons)	5,941*	4,989	19
Milk production (Liters per day)	16.28	13.66	19
Total dams and heifers	5,328	4,268	25
- Dams	4,021	3,286	22
- Heifers	1,307	982	33
Animals in milk	3,485	2,549	37
Value of raw milk sold (in million Php)	39.84	Not available	
- Sold to milk feeding program	10.53	Not available	
- Sold to commercial market	29.31	Not available	

*: Accounted for 54 percent of total production of 11 million kilograms in 2003
Source: NDA Annual Report for 2003

The NDA has assisted smallholder farmers to become members of the primary dairy co-operatives. To increase production of milk, the NDA has been supporting these co-operatives with initiatives for provision of technical services, access to credit, business enhancement, capability building, etc. In order to centralize processing and marketing of milk, these primary cooperatives have formed themselves into dairy federations. During 2003, there were 221 primary co-operatives and five dairy co-operative federations in the Philippines. These federations undertake processing and marketing while its member primary cooperatives concentrate on production of milk. The NDA has established four milk processing plants, one each in Luzon, Visayas and two in Mindanao. The milk processing plants were being operated and managed by the cooperatives under a lease to own agreement with the NDA.

These federations have been federated into a confederation: the Dairy Confederation of the Philippines. The Confederation has been very active in policy advocacy and in lobbying for support from the government and the private dairy industry.

MILK CONSUMPTION AND IMPORTS

The Philippines has a large market for milk and milk products and during 2003 imported over 300 million kg of milk valued at approximately Php 50 billion (Table 3). The major supplier countries were Australia, New Zealand and the USA. There were 200 importers and processors and the top three accounted for 63 percent of total milk imports. Main commodity imported was skim milk powder. The market for milk and milk products has been growing due to the increasing awareness generated by the processing industry amongst the consumer.

Table 3. Milk Production, Consumption and Imports to the Philippines

Particulars	2003		2002	
	Million kg	Percent of Consumption	Million kg	Percent of Consumption
Consumption of Milk Products	326	100	298	100
Domestic Milk Production	11	3	11	4
Import of Milk Products	315	97	287	96
Import of Skim Milk Powder	106	33	100	34
Import of Other Milk Powders	95	29	96	32
Import of UHT Milk	39	12	43	14
Import of Other Milk Products	75	23	48	16

Source: NDA Annual Report for 2003

SUCCESS STORIES

A Millionaire Farmer

Development of dairying has many challenges. Nevertheless the story of Mr. Victorino Caño of Mindanao, a mechanical engineer with the Marinduque Industrial Mining Corporation, becoming a full-time farmer and a dairyman, has been an inspiration to many.

Mr. Caño started his farming venture with 1.4 ha of land. He planted ramie, coconut trees and intercropped with black pepper, coffee and banana. He got training in keeping dairy cattle and availed of the NDA three-cow module in 1990. He became a member of the Riverside Dairy Farmers' Co-operative (RIDAFCO). The NDA's dairy technologist trained him to process fresh milk/flavored milk through a kitchen-type process. Along with other farmers he peddled the processed milk to Davao City. Though it was hard work, Mr. Caño found the daily cash a good return for him and his family.

As of 2004, Mr. Caño had 2 junior bulls and 21 females of which 5 were in milk producing 50-60 liters per day. He has acquired more land and has developed a part into a pasture for his animals. His milk production provides him at least Php 25,500 per month. He earned Php 86,500 from sale of animals (Table 4).

Table 4. Performance of Cano's Farm

Assets/Sources of Income	Income in Php
Dams/mature stocks: 21 @ Php 35,000 each	735,000
Junior bulls: 2 @ Php 12,000 each	24,000
Daily milk sales (50 liters/day at Php17.00/liters)	850
Average monthly milk sales (850 x 30 days)	25,500
Annual milk sales	306,000
Sale from animals (2003 only)	86,500
Income from other farm products	50,000

1 US$ = 54.2 Php (Philippine Peso)

An accolade to the success of Mr. Caño is that he has been a director on the Board of the RIDAFCO for many years.

An analysis carried out by the author suggests that the factors contributing to the success of Mr. Caño were:

1. ***Good Animals and Management:*** Mr. Caño kept good quality animals, maintained them through efficient herd management, had a well maintained pasture and gave appropriate feed supplements. He applied his knowledge learned during the three-day training on Basic Dairy Husbandry and Herd Management conducted by NDA.
2. ***Mixed Farming Approach:*** Mr. Caño did not rely solely on dairy as a source of income. His primary source of income was agriculture. He did this through maximum utilization of land resource with coconut plantation intercropped with bananas, pepper and growing Napier, signal grass for the animals.
3. ***Market Support by the Co-operative:*** Mr. Caño is able to concentrate on milk production because the RIDAFCO provided him with supporting services of milk collection, processing and marketing. The co-operative ensured regular cash flow for his family and business. It would be hard to imagine farmers doing business on their own without an active organization putting a structure to their activities and business. A strong cooperative federation managed by honest, competent and service oriented leaders, is a key contributing factor to the success of the small farmers' dairy development.
4. ***Government Support:*** The NDA continued to deploy dairy experts to support animal management, milk production, quality control, processing and business management to assist and guide the farmers and the co-operatives.
5. ***Family Support:*** Mr. Caño and his family, including his three grown up children, were involved in dairy business and activities for managing animals. Entire family was dedicated to their "new found" profession.
6. ***Good Climatic Condition:*** The project area in Davao City has been found to be one of the most appropriate areas of dairy production because of its good climatic condition, and feed resources.

A Millionaire Cooperative

The Federation of Davao Dairy Farmers' Cooperative (FEDDAFC) was constituted in 1992 as a federation of primary cooperatives in Davao City. It undertook collection, processing and marketing of milk produced by members. The FEDDAFC managed the NDA owned dairy plant under a lease to own arrangement. The personnel hired by the FEDDFAC were supported by experts deployed by NDA in the field of food technology, engineering, quality control and business management.

Some of the problems encountered by the FEDDFAC were the "oversized" milk processing facility in proportion to the volume of milk collected for processing; limited product lines; short shelf life of products causing losses due to spoilage and rejection; limited market for fresh milk products; inadequate marketing structure and facilities; absence of activities for product promotion and publicity; and limited government support for financial investment and working capital. The FEDDAFC was unable to access credit from banks and financing institutions. Despite all these difficulties the performance (Table 5) of the FEDDAFC has been commendable and it is now one of the "millionaire cooperatives" under the NDA assisted project areas.

Table 5. Physical and Financial Performance of FEDDAFC in 2003

Performance Parameter	Value
Physical Performance	
Milk Processed (liters)	376,574
Raw Milk Purchased (liters)	338,984
Product lines	Percent of Milk Processed
- Fresh milk	20 percent
- Flavored milk	60 percent
- Candies/confectionaries	5 percent
- White cheese	5 percent
- Sterilized milk	10 percent
Financial Performance	
Cost of Raw Milk Purchased	Php 5,087,760
Income from Sales	Php 11,085,886
Profit/Loss	Php 987,281
Total Assets & Liabilities	Php 4,866,922

Source: FEDDAFC Annual Report 2003

An analysis carried out by the author suggests that the factors contributing to the success of the FEDDAFC were:

1. ***Leader Democratic Organization:*** The FEDDAFC has been a very dynamic organization owing to its strong democratic principles of functioning where the general assembly was supreme; each member had a voice and was listened to; leaders were competent and service-oriented.
2. ***Professional Management:*** The FEDDAFC has qualified, trained and dedicated personnel to manage the systems of milk processing, quality control, product diversification and marketing.
3. ***Modern Plant:*** The dairy plant had modern equipment and machinery that was maintained and kept in good working condition. Personnel were trained to undertake preventive maintenance to have least breakdowns and were capable of crisis management and troubleshoot the breakdowns.
4. ***Government Support:*** The government provided adequate support through training programs and updating the knowledge of technical know-how. The government and private sponsors have been providing financial support for milk feeding programs. This has ensured ready market for the milk products manufactured by the FEDDAFC. The milk feeding programs have however been subjected to availability of funds.
5. ***Good Cash Flow:*** The FEDDAFC has maintained a good cash flow and paid its farmer-members on time. This has encouraged the farmers to continue and expand their dairy farming activities.

CHALLENGES FOR DAIRY DEVELOPMENT

Although there has been double-digit growth rate over the last two years, the smallholder milk producer has struggled to sustain dairy farming. Some of the basic problems and constraints encountered by the dairy farmers are: low milk yield of animals; scarcity of good quality and inexpensive feed and fodder; poor quality of milk produced; lack of capital and inability of the farmers to access soft credit from the banks and financial institutions. This has hampered their growth of the dairy farm size. The purchasing cost of animals has been prohibitively high. The facilities for breeding cattle and improving their milk potential have been inadequate.

While the producers have been members of the dairy co-operatives all the federations have not been able to perform as well as the FEDDAFC. They have been facing difficulties in developing market for fresh milk and milk products; had limited product lines in their processing plants.

The NDA and the farmers' co-operatives have recognized these problems as key contributing factors hindering sustainable dairy development. To counter these, some measures being jointly undertaken are:

1. ***Co-operative Support to Farmers:*** The farmers' co-operatives would set up their own feed mixing machines and provide good quality feed supplements at inexpensive prices to its members. The co-operatives would help the farmers in procurement and use of locally manufactured farm equipment such as milking machines, grass choppers, feed mixers, etc.
2. ***Training to Farmers:*** The NDA and the co-operatives would conduct training programs and seminars to enhance farmers' know-how in backyard dairy particularly on the aspect of feeds and feeding management and overall herd management, etc. The government technicians and dairy experts would continue extension service and monitoring.
3. ***Credit to Farmers:*** The government financial institutions such as Land Bank and Quedancor would allow special credit windows to the "less bankable farmer borrowers" and grant them credit facilities at liberal terms and conditions.
4. ***Farmers' Representation by the Apex Co-operative:*** The Dairy Confederation of the Philippines lobbies with the government to support the dairy sector and smallholder farmers on such sensitive issues as tariff protection; dumping; credit facilities, etc. The Confederation submitted a position paper to the Tariff Commission on retaining the existing tariff rates on dairy products if not increasing further. The confederation and NDA have been advocating policy for industry support by the private sector particularly the importers and milk processor. The NDA has been active in linking the local milk producers and the key industry players. As of 2002, 10 companies complied with Section 17 of RA 7884 that prescribed that the processors and importers of milk and milk products should first purchase the domestically produced milk for manufacturing products.
5. ***Improving Performance of Animals:*** The government through the NDA is continuously training farmers in becoming good AI technicians. Government technicians and veterinarians are also being deployed to make the AI and animal health programs work efficiently. The NDA with the assistance of Israeli experts and the International Atomic Energy Association, installed the herd registry system for recording the milk production and other performance data starting with animals imported in 2002. The recording system helped in tracking of performance of animals.
6. ***Provision of Milk Feeding Fund:*** The government has provided subsidies and the private sponsors have been giving grants and donations to give milk for the below-normal weight preschoolers and grade one pupils. This program has helped development of market for milk as well as improving the health of growing children. The availability of fund has not been regular.

OPPORTUNITIES FOR DAIRY DEVELOPMENT

1. ***Huge Market for Milk and Milk Products:*** The Philippines has a Php 54 billion market for milk and milk products. The liquid milk market accounts for 12 percent of total milk imports. The domestic milk production is just Php 6.50 billion and more production is required to meet with increasing demand for milk and milk products.
2. ***Favorable Government Policy:*** The Dairy Development Act of the Philippines. (RA 7884) provides favorable conditions for promoting local dairy and domestic milk production. Through the NDA the government is supporting the farmers and development of farmers' dairy co-operatives.
3. ***Export Potential:*** In 2003 the Philippines exported a total of 27,240 tons of milk products consisting of milk, cream, butter and cheese. It is possible to increase the exports on the strength of increasing domestic production.
4. ***Production Competitiveness:*** The Philippines has vast resources of land, human capital, and technical know-how. If properly tapped the Filipino farmers can produce large quantity of milk at cheaper cost than milk produced by many of the developed nations. The Philippines can withstand international competition.
5. ***Trade Liberalization:*** Trade liberalization is both an opportunity and a challenge. The Filipino farmers should position their industry to take this as an opportunity.

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14. SRI LANKA

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INTRODUCTION

The consumption of milk in various forms has been very long standing tradition among the population. Dairy farming is a small farmer household venture for production and sale of surplus milk. Landless estate labor families mainly do dairy production on small-scale mixed farming through family labor and within the estates. Farmers owning less than 1 ha keep 45 percent of cattle and 37 percent of buffaloes. And 46 percent of cattle and 33 percent of buffaloes on 1.1-2.8 ha farms. The cattle population in Sri Lanka in 2002 was estimated to be 1.8 million whilst the buffalo population was about 0.6 million and total population of milking cattle and buffalo was estimated to be 0.8 million. Dairying is a regular source of income for about 200,000 farmers and supplementary source of income for 400,000 farmers. Livestock products such as meat, milk, hide and skins, animal draught power and manure contributed 30 percent to the agricultural GDP in 2003 and dairying contributed 2.2 percent to the agricultural GDP.

FARMING SYSTEMS

Five major dairy farming systems have developed in Sri Lanka, viz., the Estate System; the Mid Country Small Holder System; the Coconut Triangle System; the Urban Jaffna System; and the Small Holder Buffalo System. Grazing and stall-feeding are practiced according to the type of dairy farming undertaken and the availability of land.

Ninety percent of the total cattle are non-descript indigenous animals, the Lanka cattle. Only 10 percent are of temperate breeds, e.g., Holstein, Frisian, Ayrshire, Jersey; and the Indian Zebu breeds like Sahiwal, Red Sindhi, and Tharpakar and graded Lanka cattle. As these animals vary in their ability to thrive in different environmental conditions, the distribution of the three types of animals closely follows the agroecological zonal distribution.

A concerted effort was made to upgrade the indigenous Zebu type cattle with semen produced locally and imported of temperate breeds and improved Zebu breeds. There are now over 80,000 of improved types of cattle and most of them are in the mid and the hill country region where the climate is mild.

DAIRY SECTOR DEVELOPMENT

National Milk Board (NMB) was established by the Government of Sri Lanka in 1955 to purchase raw milk from farmers and for selling the processed products in the urban areas where there was the greatest demand for milk. The NMB enjoyed a monopoly in milk collection and processing until the mid 1980. By this time the NMB was operating liquid milk processing plants at Colombo, Pallakelle and Kilincochi, a milk powder plant at Ambewela, a condensed milk factory at Polonnaruwa and 83 milk chilling centers (MCC) distributed throughout the country for collecting, bulking and chilling milk prior to dispatching it to one of the processing plants.

The government developed the dairy industry by subsidising the NMB for collection and sale of milk. Initially the government covered the operating expenses of the NMB. From 1979, the government defrayed expenses incurred by the NMB on actual milk collected and used for the production of milk powder.

Private Sector Dairies: As the increase of milk collection did not match the government investment, a decision was taken to adopt privatisation as a strategy for development of the industry. The

condensed milk factory at Polonnaruwa was converted into a joint venture between the multinational Nestle and the NMB in 1986. Nestle established a milk drying plant with a capacity of some 240,000 kg per day at Pannala in the Kurunegala District in 1983-84.

In 1984, the World Bank funded Dairy Development Project was implemented to support the long-term development of the dairy industry in Sri Lanka. The Government made many structural changes as envisaged under the project. The Dairy Development Foundation (DDF) was established in 1984 as nonprofit limited liability company to receive and provide finances for investment in dairying as well as for imparting training, providing technical assistance, research and development and management support in organizing and developing milk production, collection, processing and marketing. The Milk Industries of Lanka Company Limited (MILCO) was formed in 1985 a limited liability company as a successor of NMB in September 1986. The World Bank withdrew support for the project in December 1987.

Milk Pricing: The domestic production has remained stagnant over the last two decades. The reason for this situation has now been identified as being the low price paid to the milk producer. The cost of the production of milk in Sri Lanka has sharply risen mainly due to the increase in prices of inputs, particularly to the increase in price of coconut *poonac* and compounded cattle feed, while the price paid to the milk producers has shown no compensatory increase. As of 2003, the government "sets" the producer price for raw milk to be paid by MILCO. The price is paid to the farmer based on fat percent and SNF percent in milk. The minimum standard is fixed at 4.3 percent fat and 8.4 percent SNF. For the private sector the government follows a policy of market competitiveness and the market situation is allowed to determine the prices between suppliers and private processors.

MILK PROCESSING MARKETING AND IMPORT

Milk processing industry comprises the liquid milk processing plants and the powder repackaging plants. The government-owned MILCO and the multinational private company Nestle Lanka Ltd. (NLL) are major buyers of domestic milk. They respectively collect 51 percent and 34 percent and other 10 small-scale processors collect balance 15 percent (Table 1). Main products are: pasteurized milk, sterilized milk, cheese, yoghurt and ice cream. The NLL and MILCO produce whole milk powder by recombining local milk with imported skim milk powder and butter oil. There are several companies packing imported milk powders and infant milk powders into consumer packs. The two largest brands are 'Lakspray' by Lanka Milk Foods and 'Anchor' by John Overseas Limited.

The unorganized milk-processing sector comprises a large number of small operators producing yoghurt, curd, and selling unprocessed raw milk directly to consumers. In 2003 there were an estimated 1,000 small-scale manufactures producing 100-500 cups of yoghurt per day and around 100 small-scale ice cream manufactures.

The domestic requirement of milk is estimated at 1.2 million liters per day. Of this about 500,000 liters per day is derived from imported dried milk powder by the two major milk processors – MILCO and Nestle Ltd. In 2003, annual milk collection by major sectors is given in Table-1.

Table 1. Annual Milk Collection by Major Sectors in 2003

Sector	Quantity (Tons)	(%)
Government: MILCO Pvt Ltd.	45,399	51.2
Private Sector (8 companies)	42,603	48.8
Total	88,002	100

In 2003, the domestic milk production met 15 percent of milk consumption, while the imports constituted 85 percent. Foreign exchange spent for milk imports has been increasing from SLR 3.6 billion (SLR= Sri Lankan Rupee; 1US$ = SLR 60) in 1993 to SLR 11.5 billion in 2003. Milk and milk products are imported from Singapore, the United Kingdom, India, Australia, New Zealand, the Netherlands, Japan, Malaysia, France, Ireland, the U.S.A., China, Canada, the UAE, Turkey and Indonesia. The breakdown of the importation of milk and milk products is given in Table 2.

Table 2. Import of Milk and Milk Products in 2003

Product	Quantity (Tons)	(%)
Milk & Cream	364	0.27
Milk Powder: Fat<1.5%	2,210,408	19.18
Milk Powder: Fat>1.5%	50,125	74.97
Condensed Milk	52	0.14
Cheese & Curd	1,280	3.44
Butter & Other Fats	1,100	1.27
Butter Milk etc.	74	0.06
Whey	1,296	0.66
Total	67,911	100

FARMERS' ORGANIZATIONS

Dairy Cooperative Societies: Sri Lanka has primary dairy cooperative societies of farmer members and secondary dairy cooperative unions formed by affiliating primary cooperatives. During 2003, there were 167 registered dairy cooperative societies, which can be classified into three categories according to their organizational structure viz., small primaries, large electoral level primaries and district level large primaries. The broader objectives of the primary cooperatives are: (a) to pay the farmers fair price for the milk; (b) to provide veterinary services; (c) to arrange marketing of milk; (d) to educate and train members in improved animal husbandry practices; (e) to provide credit facilities; (f) to promote the development of pastures and concentrate feed; (g) to promote the thrift and saving habits; and (h) to convert portion of the collected milk into rural value added products.

The small primary dairy cooperative societies also called Dairy Producer Association (DPA) generally cover relatively small area of 3 km radius. They do not have branches. Their byelaws are based on 'AMUL' pattern of cooperatives in India. The DPA has an average 50 members and operates in 3-4 villages. A management committee comprising six or nine elected members, one of whom is elected as the chairman, administers the DPA. All members constitute the general body that approves the decisions taken by the management committee. The management committee appoints a secretary to keep records, manage finance and to collect milk. He administers day-to-day activities. The DPA coordinates with the union for transportation of milk, input supplies and other services.

Dairy Cooperative Unions: The union is a secondary level organization representing the primary societies. A union is managed by a board of directors and implements programs through the general manager. There were six district unions in Sri Lanka. The main functions of the unions are: (a) to purchase and transport milk collected by the primary societies; (b) to process and market, milk and milk products; (c) to provide animal health care, artificial insemination and extension services; (d) to undertake the production and distribution of cattle feed to primary societies; and (e) to organize and sustain the dairy cooperatives which would ultimately supply the essential raw material-milk to the processing plant of the Union.

Self-Managed Farmer Societies: Organizing farmer-managed organizations is a principal strategy used by MILCO. In 2003, MILCO had 1601 self-managed farmer organizations with 31,000 registered members and 60,000 farmers (including member) who supplied milk. Similar self-managed farmer organizations supply milk to private dairy processing companies and dairy cooperatives. Majority of the farmers are very small landholder and landless. They lack the knowledge and information their rights to bargain and realize better price from the dairy processing companies. MILCO has trained four spearhead teams for social mobilization process at village level and facilitating the creation of self-managed societies. A team leader who has experience in social mobilization and technical knowledge of dairy and livestock development heads a spearhead team. The spearhead teams impart training to dairy farmers on hygienic milk production, economic milk production, building the capability of secretaries/center managers, conducting animal health and animal breeding camps. The spearhead team identifies local leaders for the self-managed farmer organizations and develops accounting and auditing systems for viable milk collection and marketing. MILCO and NLDB have few trained spearhead teams. To speed up this process there is need to larger number.

Initially, the farmer was paid on a flat rate price for the milk sold to the society. This was very unsatisfactory method of payment. Later, the society introduced lactometer to test for SNF content and Gerber test for checking fat content of milk. The fat tests method was time consuming and the payment made was inaccurate. Farmers were still frustrated. During the mid-1970s, milko tester was introduced. Being an electronic gadget it gave result of fat content instantly. Since the farmers saw the result they developed confidence in the society and the MILCO, and were encouraged to sell more milk.

A small-scale dairy farmer as an individual has no social recognition. As a member of the society he is recognized. The MILCO has organized many benefits to the farmers through these societies. An insurance scheme – Dairy Farmer Social Security Fund – has been started by MILCO. Under this scheme, the MILCO and farmer contribute 25 cents per liter of milk. From this scheme a farmer is granted: (a) child university entrance grant of SLR 10,000; (b) fifth standard scholarship of a child SLR 5,000; marriage SLR 75,000; birth of a child SLR 2,000; daughter's puberty celebration SLR 3,000; paralysis SLR 25,000; bypass operation SLR 50,000; and at the death of the farmer SLR 50,000.

CONSTRAINTS FOR DAIRY DEVELOPMENT

In surplus milk producing areas milk production is based on high yielding temperate dairy breeds or their crosses, capable of high milk yield. They are adequately fed. In hill country and mid country the estate workers or small holders keep dairy cattle on a limited land area for forage and pasture production. About 60 percent of milk collected by NMB/MILCO is obtained from this region. The drought conditions in the past years reduced production of coconut and other crops. This increased the price of coconut *poonac* as well as other feed ingredients. This has reduced production of milk in the hill and mid country by 12 percent. With the development of Mahaweli basin, more land has been come under irrigated cropping reducing area under grazing lands.

Availability of feed and good quality fodder has been a major constraint in increasing milk production. The indigenous grasses have less than 12 percent protein as against the minimum of 16 percent protein required for the milk cows. Recently some experts have suggested that high-protein-high-TDN feed should be given to the up country high milk yielding cows and a low-protein-low-TDN feed be given to the unimproved cows in the dry zone. Against an estimated annual 300,000 tons of cattle feed required, about 160,000 tons of animal feed ingredients are locally available, but only one third (1/3) of these are processed in Sri Lanka's major feed mills. The coconut *poonac*, a major component of cattle feed, is exported in large quantities. Costs of feed ingredients account for about 70-85 percent of the total cost of compounded feed.

Non-availability of good cattle has been a constraint for new entrants to dairy farming. For replacement, the farmers rely for imported heifers from state farms that are equipped to supply only 3,000 heifers a year. The Ministry of Agriculture and Livestock provides free inputs to promote small farmers to rear heifer-calves for future replacements. Other problems are: calf mortality rate of 25-40 percent in the exotic cattle and high crossbreds in the hill and mid country zones; maturity to milking age of 36-48 months; and the ban on cow slaughter keeps 30 percent of female adult cattle unproductive and selection of good genetic stocks is hampered. The unproductive stock competes for feed with productive animals.

The artificial insemination (AI) is not effective tool for breeding of animals because of lack of trained manpower and supporting infrastructure facilities. During 2003, there were about 250 veterinary and 850 para-veterinary personnel. In addition to AI, the veterinary officers have to perform many activities, e.g., organizing DPAs; provide technical services for animal feeding, management; farmer's training, veterinary medicines and supply semen. The DAPH concentrates on an improvement of the indigenous livestock by crossbreeding through natural and artificial breeding methods. As per the policy, indigenous breeds in mid country, coconut triangle, low country wet zone and dry zone areas are upgraded to 50 percent bulls, whereas in hill country and Jaffna peninsula cows are bred to purebred temperate bulls.

Foot and Mouth Disease is endemic despite regular vaccinations. Outbreaks of Haemorrhagic septicaemia are common in dry zone and the mortality and morbidity are high. The economic loss of production from mastitis is very significant compared to other diseases. Mastitis is common amongst high milk producing crossbred cows in mid and hill country. This also affects the quality of milk and is

a major cause of rejection of milk at the chilling centers. The other diseases of economic importance which hamper the growth of dairy industry is Brucellosis which is endemic in dry zone cattle. The losses due to Brucellosis amounted to 8.5 percent of national milk production in 1994. New diseases are being introduced to local cattle through imported animals, imported unprocessed meat. Some drawbacks in the disease investigation and control are: (a) insufficient coverage of quarantine regulations in the legislative enactments; (b) insufficient facilities and personnel for quarantine; and (c) lack of facilities for veterinary disease investigation.

One of the biggest constraints to dairy development in Sri Lanka is the low price paid to farmers for milk. The farm gate price received for milk by the producer with the recent increase by MILCO and Nestle is still very low. Low price is a serious disincentive. The present ratio of milk price to concentrates price is 1:1.33. This is the reason that farmers are reluctant to raise the young stock themselves. They prefer to sell all the milk rather than feed calves. There is gross inconsistency in price paid to producers for milk vis-a-vis cost of feeding. To be economically viable for the farmers the price of milk should be higher than the price of concentrates. If the producer price for milk were increased, many problems would be solved. It will help the farmers to obtain institutional credit for expansion and motivate to learn better husbandry skills.

The unrestricted import of cheap milk has been responsible for depressed dairy production in Sri Lanka. The import price of the powdered milk is artificially low because of export subsidies given by countries surplus with milk powder. This low price is a benefit to the consumers but to a disincentive to smallholder milk producer.

The inappropriate milk collection and chilling network in Sri Lanka is a disincentive for the farmers to produce milk. Nestle and MILCO chilling plants have low capacities, have duplicated their facilities in the same areas and some of the chilling centers are not located in feasible areas. This increases the cost of chilling and procurement. Therefore, major share of milk is collected through middlemen who exploit the producers. This has restricted the milk procurement from villages to as low as 35 percent of the marketable surplus. Thus the farmer receives a low price. Because of limited purchasers and many sellers in the rural market, fresh milk market is a “buyers market” than a “sellers market”. The farmer is at a decided disadvantage.

The dairy sector development has been constrained by the lack of both forward planning and inconsistent policies. Both the public and private sectors have lost confidence for participating in the development of the industry.

CHALLENGES AND OPPORTUNITIES

Sri Lanka imports milk and milk products from countries that subsidise their production and export. These products are sold in Sri Lanka at prices that are lower than the cost of production of marketable milk and milk products from the milk produced in Sri Lanka. This depresses milk production and is a big challenge to dairy industry in Sri Lanka.

Milk is highly perishable commodity and can be used as food directly and quickly. From the time of collection to product manufacture and distribution to consumer it needs highly developed infrastructure facilities to maintain its quality. The government of Sri Lanka has liberalized trade and advanced technology for low cost can be obtained from other countries.

Sri Lankan farmers traditionally give coconut *poonac* to dairy animals as concentrate feed. Since the price of coconut *poonac* has increased and is high as compared to price for the milk received by the farmer producing milk at a cheaper cost is a main problem. There are possibilities of producing concentrate feed through importing low cost raw materials such as maize, sorghum, etc. For the concentrate feed manufactures government is giving duty concessions for importing raw materials for feed manufacturing.

For producing better quality cattle Sri Lanka should collaborate with the countries that have successfully developed dairy animals through crossbreeding, e.g., Australia for Australian Milking Zebu, and India for Sunandani.

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15. THAILAND

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INTRODUCTION

Thailand was one of the tiger economies of Southeast Asia, during the eighties and nineties. For over a decade economic growth averaged 9 percent per annum. The economic crisis of 1997 was caused by persistent current account deficit and there was a marginal contraction in the growth of the economy. The Thai Baht and domestic demand collapsed and imports declined by more than 33 percent. The national currency Baht was devalued. Tough measures—including passage of adequate bankruptcy and foreclosure legislation as well as privatization of state-owned companies and recapitalization of the financial sector—remain undone. Thailand had to fight for the labor force and those displaced by the economic crisis. As of 1998 the country's GDP was estimated at US$369 billion with an average real growth rate of 8.5 percent. Sector wise contribution to the GDP was: agriculture – 12 percent, industry – 39 percent and services – 49 percent. The population below poverty line was about 13 percent (www.dld.go.th.). Contribution of agriculture and livestock to the GDP has been consistently declining and is now well below 9 percent. The livestock sector is relatively small part of the overall agricultural sector. The dairy and beef sector contributed an insignificant 0.8 percent in 1998 to the GDP.

DAIRY SECTOR

Dairy farming in Thailand was started during the 1940s by Indian settlers, who used milk for home consumption. The Thai people were introduced to milk during the 1950s by the United Nations and the Thai Government through distribution of milk powder in health clinics and schools. The first dairy farm was set up with Thai-Danish collaboration at Muak Lek in Saraburi province in 1962 and after privatization in 1990s it continues to be one of the largest producers' organization. The Ministry of Agriculture and Cooperatives has identified dairy farming and milk production as a potential source for improving the nutritional status of the population, for saving foreign exchange, and to improve the incomes of rural poor landless and marginal land owners. In 1971, the government set up the Dairy Farming Promotion Organization (DFPO) with the objectives to: promote dairy farming; provide training in dairy husbandry through extension work; and to develop the processing of milk products. The DFPO is supported by the Department of Livestock Development in providing the veterinary services, artificial insemination and training and infrastructure facilities required for development of livestock and milk production. In 1978, the DFPO drew up a 10-year plan to make the country self-sufficient in fresh milk production. In 1983 the Thai Government introduced permit system for import of milk powder and made it mandatory for the industries to use at least one part of raw fresh milk for every part of recombined milk (Chantalakhana, 1995 quoted by FAO, 2002). Recently the government has set up the National Board of Livestock Policy and Development as an agency of livestock development implementation. The board comprises representatives from public sector, private enterprises, and dairy farmers (www.dld.go.th. 2005).

* Dr. Rattan Sagar Khanna is the editor of this publication but substantially contributed to the content of this paper, much more than usual editing.

Thailand had an estimated 6.7 million cattle in 1997, an increase of 2.3 million from those in 1984 (FAO, 2002). The greatest proportionate increase occurred in the Northern region, while the slowest growth occurred in the Southern region. According to the latest statistics by the Department of Livestock Development, Thailand has seen steep decline in the total population of cattle and buffaloes during the last decade (Table 1). The redeeming factor has been the increase in the number of dairy cows. The increased mechanization that has occurred in Thai agriculture has resulted in the replacement of buffalo by tractors and other mechanical implements; this trend is likely to continue. The number of buffaloes declined from 4.66 million in 1994 to 1.6 million in 2003. Most of the buffalo are found in the Northeast region. Thailand has been importing live cattle for use as breeding animals and for fattening from Australia, New Zealand, Myanmar and Costa Rica. The beef cattle were exported to some of the neighboring Southeast Asian nations generally Laos and Malaysia.

Table 1. Population of Cattle and Buffaloes in Thailand

Year	Cattle	Dairy-cow	Buffaloes
1999	4,755,792	339,265	1,911,518
2000	4,601,697	352,010	1,711,573
2001	4,640,355	365,209	1,523,627
2002	4,819,713	377,263	1,612,534
2003	5,048,170	392,625	-

Source: Department of Livestock Development (2005) www.dld.go.th

Agriculture and milk production activities in Thailand are rural-based and generally undertaken by small landholders. The statistics on landholding (Table 2) pattern indicates that while the number of holdings is increasing the size of land held by farmers is declining; 45 percent of the farmers have farm size lesser than 3 ha of land. Some 84 percent of the farmers have lesser than 9 cattle. In Thailand, the dairy industry and crop production activities have been synergistic. Some farmers in the Central Plains have shifted from cultivating rice to grass (fodder) for dairy cattle. Dairy farming requires a relatively large capital investment to construct cowshed, purchase dairy cows. In 1990s a good dairy cow would cost between Bt15,000 and Bt20,000 (about US$600 to US$900 at the exchange rates prevailing then). The conditions for getting loan from the BAAC included conversion of rice land, allocate at least 5 rais of land for cultivation of grass per dairy cow and purchase at least five dairy cows (Sectoral Economics Program 1995). Loan was given for purchase of cows and building shed. The loan carried an interest of 9 percent per year with a moratorium of seven years for capital repayment. The government guaranteed the price of milk to these farmers.

Table 2. Distribution of Holders and Landholding Size and Farm Size in Thailand (Modified from FAO, 2002)

Year	1978	1993
Number of Agriculture Holdings (000)	4,017	5,647
Holding size		
Less than 6 rai	17.0 %	21.4 %
6 to 9 rai	12.5 %	13.3 %
10 to 39 rai	54.8 %	52.3 %
40 rai and above	15.7 %	13.0 %
Number of Cattle Farms (000)		1,263
Number of Cattle per Farm		
1 - 4		59.5 %
5 - 9		24.3 %
10 - 19		10.2 %
Above 20		6.0 %

One rai = 1,600 square meters approx.

Source: Thailand Development Research Institute (1997); National Statistics Office (Quoted in FAO 2002)

In the Seventh National Plan, the Department of Livestock Development had programs to improve production efficiency. The efficiency was improved through artificial insemination, better feeding, and good healthcare and management provided to the cattle and buffaloes. The outcome of these projects, according to the Department of Livestock Development (1996) was to increase production from 7 kg to 10 kg per cow per day. The number of cows also increased from 165,700 in 1991 to 266,100 in 1994. Milk production overall increased from 193,000 tons in 1991 to 326,400 tons in 1994. Farmers prefer cows than buffaloes in their dairy herd. The price of milk being paid to the farmers has been increasing but not adequate. The price of milk was also determined by the quality particularly the fat and protein content. Most dairy farmers rear cows and bulls for beef purposes also.

DAIRY COOPERATIVES

The government Cooperative Promotion Department encouraged the establishment of cooperatives and monitored their management in accordance with the government regulations. The basic requirements to form a dairy cooperative were: a minimum of 60 farming families, with at least 300 cows; the farmer-member should pass a training course on dairy farming and have a minimum of 10 rai of land and 5 cows. The milk collection point should be within 20 km of the cooperative and should have an access to an approved milk market. Every cooperative should have facilities for veterinary and artificial insemination services.

In 2003, the Dairy Cooperative Federation of Thailand had 98 primary dairy cooperatives with 16,000 dairy farmers. Most farmers had 5-20 dairy cows; about 1 percent had more than 40 cows. Seven dairy cooperatives had processing units and some cooperatives had feed mixing plants. The Nong Pho Dairy Cooperative in Ratchaburi province established in 1977 is the largest dairy cooperative in Thailand. It received strong support from the royal family. It has a feed plant and a dairy plant with facilities to produce UHT milk. The government has been providing financial support to cooperatives to invest milk collection centers; in infrastructure facilities to manage extension activities for training the farmers in cooperative management; dairy cattle health and management, etc. The dairy cooperatives have milk collection centers that purchase milk from the farmers; process and transport milk and sell milk to larger dairy plants (Table 3). The cooperatives operate feed mills and sell feed to the farmers. They provide centralized facilities for bulk purchase of equipment used by dairy farmers and facilitate loans for the farmers for purchase of cattle and equipment through the Bank for Agriculture and Agricultural Cooperatives (BAAC). The milk is purchased from the farmers at a base price adjusted for such qualitative norms as: butterfat, protein, bacterial count, sediment, etc. For milk purchased the farmers are paid by the cooperative on the 5th, 15th and 25th of each month.

Table 3. Dairy Farmer Members, Cows and Quantity of Fresh Milk Collected by Dairy Cooperatives and the DFPO from 1995 to 1999

Year	Milk collection Agency	Farmer Members (No.)	Cows (No.)	Fresh Milk Production (Average MT/day)	Price (Bt/kg)
1995	Dairy Cooperatives	22,462	230,061	841.72	8.14
	DFPO	5,819	57,285	193.98	7.97
1996	Dairy Cooperatives	25,188	274,613	940.79	9.19
	DFPO	5,898	60,220	199.81	9.25
1997	Dairy Cooperatives	23,646	288,856	1,056.76	9.39
	DFPO	4,361	60,534	204.87	9.86
1998	Dairy Cooperatives	24,485	287,732	1,062.79	10.91
	DFPO	4,883	61,148	201.35	11.39
1999	Dairy Cooperatives	24,716	328,008	1,211.79	11.25
	DFPO	5,630	68,390	254.21	11.68

1 US$ = Bt 39.59 (Baht), Asian Development Bank 2003

Source: Office of Agricultural Economics; www.oae.go.th. (Quoted and modified from FAO, 2002)

MILK PRODUCTS AND IMPORTS

Thailand is a major importer of milk and milk products (Table 4). Most of the milk product, e.g., cheese, yogurt, whey powder milk replacers and baby foods are imported. Skim milk powder is one of the largest products imported and is used for making liquid milk and other derivatives. Some of the products manufactured are exported to the neighboring Southeast Asian countries. Franchises have been given to hawkers and small shops to sell bulk pasteurized or boiled milk. There is no reliable public information on the size of the informal sector.

Table 4. Import and Export of Milk and Milk Products Thailand (Jan.-Dec. 2003)

Products	Import		Export	
	Quantity (MT)	Value Million Baht	Quantity (MT)	Value Million Baht
Milk				
- Skim Milk	73,657	5,038.78	18	1.66
- Other Milk Powder	40,870	2,922.68	78,130	2,450.97
- Skim Milk Powder	46,850	1,063.58	3,469	109.74
- Cheese	16,555	1,216.60	640	23.97
- Yogurt	8,010	309.09	12,186	329.94
- Milk and Other Cream	22	2.05	19,620	675.42
TOTAL Milk	185,964	10,552.79	114,063	3,591.70
Milk Products				
- Whey Powder	22,640	403.82		
- Denatured Whey Powder	7,590	184.10		
- Milk Replacer	3,192	99.51		
- Denatured Skimmed Milk	300	13.80		
- Other Milk Products	4,328	72.60		
TOTAL Milk Products	38,050	773.83		

Exchange Rate 2003 (Asian Development Bank): 1 US$ = 41.48 Baht
Source: Thai Customs Department and Office of Livestock Standard and Certification

CHALLENGES AND OPPORTUNITIES

The dairy industry in Thailand has a problem of shortage of good quality cows and buffaloes and their price is very high. The buffaloes have poor fertility, their calving rate was around 55 percent; calving interval ranged from 18 to 22 months; age at first calving was 44 to 50 months; their draught performance was poor and there is no targeted utilization of meat. This made the buffaloes poor producers of milk and meat. The production efficiency of cattle is also low because of long calving interval of 450 to 500 days.

The farmers lack education and knowledge to manage the dairy cattle. Pastures are limited and overgrazing has deteriorated the land. The farmers feed concentrates, industrial by-products and crop residues. Increasing urbanization and jobs in the cities has caused shortage of labor in rural areas for dairy farming. Collection and transport costs of milk are high and refrigerated distribution systems are poorly developed. The use of low fat milk powder into reconstituted milk for drinking at cheaper prices makes the consumer to avoid using good quality fresh milk.

The doomsayers believe that the dairy industry has no future in Thailand. The Department of Livestock Development nevertheless expected that the demand for raw milk would increase between 9-10 percent per annum and per capita consumption, which was 6.81 kg in 1994, should be around 15 kg by 2000. Total demand of milk would be 972,210 tons in 2000 as against 403,933 tons in 1994. Most of the consumption will be in urban or semi-urban areas where marketing facilities are adequate, income level and education standards are high, and the consumers are aware of the nutritional advantages of milk. The Thai government introduced a school lunch program in 1994-95 to encourage milk consumption by school children outside urban areas.

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2. PROGRAM OF ACTIVITIES

(22-27 November, 2004)

Date/Time	Activity
Mon., 22 November	
Forenoon	Opening Ceremony
	Presentation and Discussion on Topic-I: *Sustainable Development of the Dairy Sector in Asia and the Pacific – Challenges and Opportunities* by Dr. Rattan Sagar Khanna.
Afternoon	Presentation and Discussion on Topic-II: *Milk Production and Marketing Systems in Pakistan – Constraints and Opportunities* by Dr. Mohammed Younas and Dr. Zafar Hayat
	Presentation and Discussion on Topic-III: *Role of SMEs in Development of Sustainable Dairy Development in Pakistan* by Arshad H. Hashmi
Tue., 23 November	
Forenoon	Presentation and Discussion on Topic-IV: *Management of Dairy Animal Feeding for Better Productivity and Food Safety* by Prof. Dr. Jong Kyu Ha
	Presentation and Discussion on Topic-V: *Management of Dairy Animal Breeding for Higher Productivity* by Dr. M. Sajjad Khan
Afternoon	Presentation and Discussion on Topic-VI: *Small-Scale Milk Collection, Processing and Marketing – FAO Activities* by Mr. Anthony Bennett
	Presentation and Discussion on Topic-VII: *Cost Effective Technologies for Milk Preservation and Processing by Dairy SMEs* by Prof. Dr. M. Abdullah
Wed., 24 November	
Forenoon	Presentation of Country Papers
Afternoon	Continuation of Presentation of Country Papers
Thu., 25 November	
Forenoon	Workshop
Afternoon	Workshop Continues
Free Time	
Fri., 26 November	
Forenoon	Visit Nestle Milkpak Ltd., Milk Collection Sub-center, Ali Nagar Visit Nestle Milkpak Ltd., Milk Collection Center, Bhawana
Afternoon	Visit Amir Gill Farm, Bhawana Visit Dr. Abul Hassan Farm, Jhang
Sat., 27 November	
Forenoon	Program Evaluation Summing Up Session