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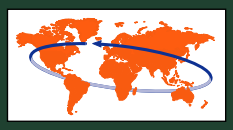

International
Farm Comparison
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A Review Of Milk Production In Pakistan With Particular Emphasis On Small-Scale Producers

Otto Garcia, Khalid Mahmood and Torsten Hemme

PPLPI Working Paper No. 3

PREFACE

This is the third of a series of "Working Papers" prepared by the Pro-Poor Livestock Policy Initiative. The purpose of this series is to review issues affecting livestock development in relation to poverty alleviation.

The livestock sector plays a vital role in the economies of many developing countries. It provides food, or more specifically animal protein in human diets, income, employment and possibly foreign exchange. For low income producers, livestock also serve as a store of wealth, provide draught power and organic fertilizer for crop production as well as a means of transport. Consumption of livestock products in the developing countries, though starting from a low base, is growing rapidly.

The purpose of this study is to assess the economics of dairy farming in Pakistan and to gauge the prospects for improving the dairy income for small-scale producers, which currently form the backbone of the dairy industry. The document begins with a general overview of milk production in the country, followed by a detailed study of dairy farming in the Province of Punjab, with a particular focus on the small-scale producers owning very few milking animals. Preliminary estimates of the margins in the dairy chain are provided. It is concluded that a dairy marketing system that caters for the needs of small-scale producers would send a strong positive signal for the latter to mobilize their resources and develop their operations.

It is hoped that the paper stimulates discussion and any feedback would be gratefully received by the authors and the Livestock Information and Policy Branch of the Animal Production and Health Division of FAO.

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Disclaimer

Keywords

Cost of production, Pakistan, milk, policy, poverty reduction, small-scale dairy farming, typical farms, Layyah, Lahore .

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1 EXECUTIVE SUMMARY

Introduction

Milk production is considered a livestock enterprise, in which small-scale farmers can successfully engage to improve their livelihood and obtain a relatively constant stream of income, thus moving from subsistence to market orientation. The main purpose of this study was to gain insight into the household and farm economics of small-scale dairy farmers in Pakistan, a country with the vast number of small-scale dairy farmers, and to obtain estimates of their cost of milk production so as to gauge their vulnerability to international competition. Furthermore, although the dairy enterprise is the main focus, income estimates are also made at the household and whole farm level. A case study approach was used, the aim being qualitative insight rather than quantitative extrapolation.

Methodology

The province of Punjab, the major milk-producing province in Pakistan, was chosen for this study. The methodology applied for the economic analysis was developed by the International Farm Comparison Network (IFCN) and utilizes the concept of typical farms. Farm types are determined on the basis of the knowledge of regional dairy experts. In the case of Punjab, typical farms were defined by (a) location in relation to the regional distribution of milk production and (b) size of the farm relative to farm sizes that make important contributions to milk production in this province. Data was collected using a standard questionnaire and a computer simulation model, TIPI-CAL (Technology Impact and Policy Impact Calculations), was used for biological and economic simulations of the typical farms. The farm input data and the related output figures were discussed and validated with local experts and farmers.

Results

Milk production in Pakistan and Punjab Province

In 2002 Pakistan reached a milk production volume of 32 million tons, slightly higher than that of Germany. Over two third of the milk is produced by buffaloes. Pakistan has over three times as many 'dairy animals' as Germany, the vast majority (over 80 percent) being kept in herds of one to three animals. Annual milk yield per dairy animal is about one fifth of that achieved in Germany and about one third of the yield of a New Zealand dairy cow.

In the province of Punjab, over twenty million tons of milk were produced in 2002, nearly 70 percent thereof derived from buffaloes. Over the past six years, total milk production has increased by around 17 percent, most of the growth resulting from an increase in the number of buffalo and cattle (local as well as cross-bred), while yield increases have contributed relatively little to production growth.

Most of the land in Punjab is irrigated allowing for the cultivation of wheat, rice, cotton, pulses, sugar cane, fodder, etc. More than 70 percent of the farmers own less than 2 hectares of land and over 80 percent of dairy farming is done by these small landholders at subsistence level. Four typical farms were selected for this study, all of which were located in the irrigated area.

Analysis of 'Typical Farms' in Punjab

Based on the IFCN methodology described, four farm types have been identified as 'typical' and were analyzed in detail:

PK-1: This farm represents a rural land-less household with 1 buffalo. The household itself consumes over 70 percent of the milk produced, the rest being sold to the local milkman.

PK-3: This farm, located in a rural area, has 3 ha of land used to grow small grain crops and owns 3 buffaloes. Over 75 percent of the milk produced is sold to a processing company.

PK-10R: This is a rural farm with 6 ha land and 10 buffaloes. The milk produced is sold to a milk processing company. This farm type is rapidly becoming more common.

PK-10U: This is a peri-urban, land-less farm near the major city of Lahore. All the fodder and feed for its 10 dairy animals (8 buffaloes and 2 cows) are purchased. The milk produced is sold directly to the consumers in the city through home delivery.

Dairy Production Systems

All four selected farms are family enterprises. Family labour represents 100 percent of the farm labour on the two smaller farms and 15 to 50 percent on the two larger farms.

On all farms the dairy animals are kept in tied stalls with no grazing. Milking is done by hand. Feed rations are mostly based on fodder and agricultural by-products such as wheat straw and industrial by-product such as cottonseed cakes. Only the two larger farms use some level of concentrate/compound feed. Buffalo are, by far, the main type of dairy animal, followed by crossbred cows. Milk production ranges from 1,100 to 1,980 kg non fat-corrected milk per lactation.

Household comparison

All farms have a diverse income structure, income sources being the sale of milk, the sale of cash crops, and off-farm employment. Annual household incomes range between US$654 (PK-1) and US$ 2,283 (PK-10R).

For the farm type PK-1 the main cash income source is off-farm employment (75 percent). The net cash income just covers the farm's cash costs and only contributes twelve percent to household income. However, the non-cash benefits from the dairy obtained by the family in the form of milk and manure have a market value equivalent to 17 percent of the household income

Whole farm comparison

Total farm returns range from US$ 236 to 6,400 per year. Net cash farm income follows a similar pattern as that of the farm returns. The net cash income of farm PK-1 is only US$ 79 per year. This is mainly due to the low share of milk sold. The highest net cash farm income (US$1,950 per year) is achieved by farm PK-10R. Interestingly, although the two larger farms have similar farm returns, net cash farm income of PK-10R is 1.8 times that of PK-10U. This dramatic difference is a result of PK-10R's much lower production costs.

Comparison of the Dairy Enterprise - Costs of Milk Production

Farms PK-3 and PK-10R, both having land to grow crops and forages, are able to produce milk at a cost of US$ 11.65 and 8.50 per 100 kg. These farm types have the potential to compete with imports of dairy products and also to produce milk for export, provided international quality standards can be achieved and the dairy chain being internationally competitive. It should be mentioned that the farm PK-10R is one of the most competitive dairy farms analysed by IFCN in 2002 (IFCN Dairy Report 2003) and has lower production costs than the farms in Australia and New Zealand included in the international comparison.

The cost of milk production of farm PK-10U is over 2.20 times higher (an additional 10 US$ per 100 kg milk) than that of PK-10R. This is due to much higher input costs as a result of PK-10U depends on purchased green fodder and concentrate. However, the high milk prices obtained (an additional 10 US$ per 100 kg milk compared to PK-10R) compensates for the additional production costs. PK-10U fully covers its production costs and should be economically viable in the long run.

The cost of milk production of farm PK-1 amounts to US$18 per 100 kg and is thus significantly higher than the cost incurred by farms PK-3 and PK-10R. This can be explained by economies of scale of the other farms and low milk yields of PK-1. Without major improvements farm type PK-1 will, in the longer run, have difficulties to compete with the other farm types. At the moment, however, the main purpose of PK-1 is to produce milk for home consumption by converting available roughages into milk, livestock for sale, and fuel as well as to provide the female members of the family with an income-generating activity.

As in small dairy farms in most other countries, farm PK-1 will keep its dairy animals as long as alternative employment opportunities (at US$ 0.16 per hour in this case) are not available. Keeping livestock for PK-1 households is the function of asset storage as poor households rarely have access to savings institutions. Therefore livestock is an important asset, which can be liquidated at any time in case of a financial crisis. Apart from these financial considerations, personal preferences and family traditions are likely to slow down the speed of structural change in these subsistence milk production systems.

Dairy chain in Punjab (preliminary estimates)

Consumer prices for fresh milk are 1.5 times higher in the formal than in the informal sector. If milk adulteration (i.e. adding water to increase milk volume) is not taken into account, the margin for milk processing and retailing in the formal dairy sector in Punjab seems to be around half of what dairy chains in Europe take to deliver the milk to the consumer. The informal sector has a margin of US$ 0.06 to 0.11 per kg of fresh milk (6 percent fat), while the margins in the formal sector amount to US$ 0.18 to 0.36 per kg fresh milk (6 percent fat milk). The highest margin is obtained in the UHT milk chain, 5 percent of Lahore's milk consumption, which has a processing and retailing margin of US$ 0.36 per kg of fresh milk (6 percent fat). The value of the extracted cream lies between US$ 0.05 and 0.09 per kg of fresh milk with a 6 percent fat content.

Key Conclusions

Milk production in Pakistan has increased by 17 percent from 1996 to 2002. This increase in production was mainly achieved by a growth in the number of dairy animals (15 percent for the same time period) with only slight gains in milk yield per animal with the use of artificial insemination (AI) techniques for breed improvement. Considering that most of the increase in inventory and milk production stems from small-scale farms, there should be a great opportunity to improve the livelihoods of these small-scale producers by providing enabling framework conditions.

Assisting farm type PK-1 is key to impacting the bulk of dairy farmers in Punjab, who also represent a high proportion of the rural poor in the province. This type of farm requires interventions that allow the household to make an entrepreneur's profit. Finding a sustainable technology or policy interventions aiming at improvement of subsistence production and at the same time avoiding market distortions could be a valid starting point. But it is doubtful if it is possible to increase market integration of the majority of subsistence oriented dairy producers. Nevertheless, low cost technology interventions such as vaccination and AI campaigns also benefit the rural poor in terms of decreasing the animal mortality loss and increasing the yield. The small dairy farms with some land, such as PK-3, probably have the resources to capitalize faster on most new opportunities than the smaller farm type (PK-1). Also, PK-3 clearly shows a much more intensive and commercial management approach to its crop enterprise than to its dairy business. Thus, this type of farmer knows how to produce commercially and presumably could, under the right conditions, transfer his know-how from one enterprise to the other quite quickly.

A sound intervention strategy to strengthen the position of the small scale dairy farms would focus simultaneously on at least three fronts: (1) lowering farm production costs, (2) increasing productivity and (3) promoting a "higher" farmers' share in the consumer milk prices. A more competitive milk marketing system that is designed to cater for the needs of small-scale dairy farmers would send strong positive signals for small farmers to mobilize their own resources and develop their operations.

Dairy chain is the central stimulus for all the developments in dairy sector of the country. Due to the central development role played by the dairy marketing chain, a more comprehensive analysis of its operations than that presented in this study is required. The way the dairy sector operates can, in a couple of years, either boost small-scale dairy farming or eliminate progress made during decades of efforts.

2 OVERVIEW – MILK PRODUCTION IN PAKISTAN

2.1 Pakistan Dairy in the Global Context

World Milk Production

In 2003 Pakistan produced 32 million tons of milk, which amounts to 6 percent of the total world milk production. Put differently, Pakistan produces about 40 and 45 percent of the amount of milk produced in India and USA, the world's largest milk producing countries, respectively.

Dairy Farm Structures

Over 70 percent of the farms have less than 2 hectares and keep an average of 1-3 dairy animals per farm.

Milk Yields

Comparison of average milk yields across various countries shows that one New Zealand dairy animal produces as much milk as three "dairy animals" in Pakistan; while one American cow produces as much as seven Pakistani cows. This dramatic difference in productivity is due to a variety of factors (genetics, management, technology, etc.) Fortunately, many of these factors are known, which means that there is great potential for the development of the local dairy sector.

Dairy Animals

Pakistan has about three times the number of cattle as Germany; and around one fourth the number of buffaloes in India.

Milk Prices

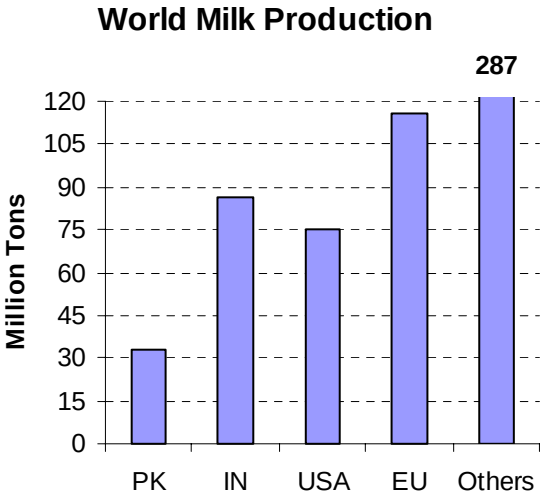
All these previously mentioned countries have higher farm gate milk prices than Pakistan. USA and Germany provide generous farm subsidies, which result in more than double the farm gate milk prices paid in Pakistan.

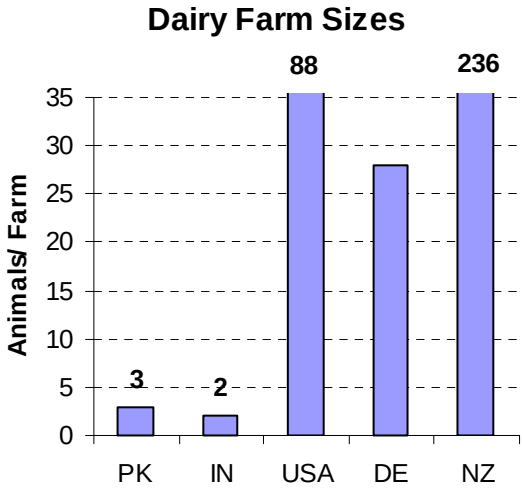
Milk Production per Capita

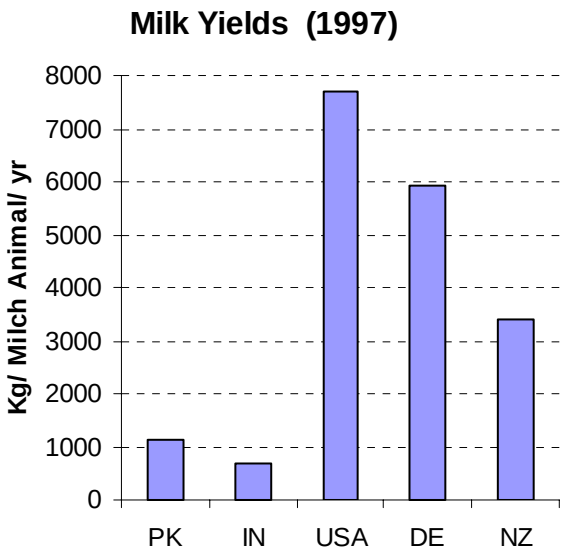
Pakistan has a per capita milk production of around 230 kg per year, which is more than twice that of India and about 70 percent that of the USA. The recent growth in per capita milk production has been driven by the increase in the number of dairy animals rather than by milk yield improvements.

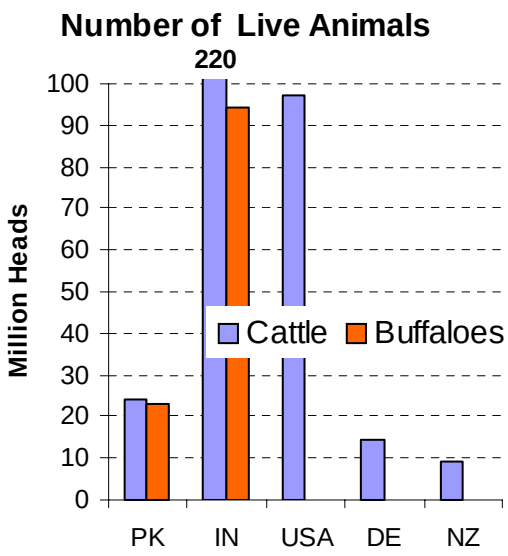
Explanations of variables; year and sources of data:

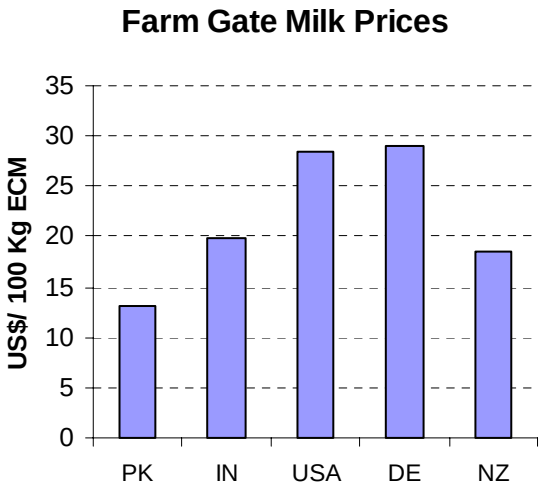
- Milk Production per Country (2002): FAO Statistical database on March 2003, (http://www.fao.org).
- Average Farm Size (2000): Agriculture Statistics of Pakistan 2000.
- Milk Yields per Dairy Animal (2000): Agriculture Statistics of Pakistan 2000
- Number of Live Animals (2001): FAO Statistical database on March 2003, (http://www.fao.org).
- Farm Gate Milk Prices (2002): Strategy Development in Milk Production and Distribution, 2000
- Production per Capita (2001): FAO Statistical database on March 2003 (http://www.fao.org).

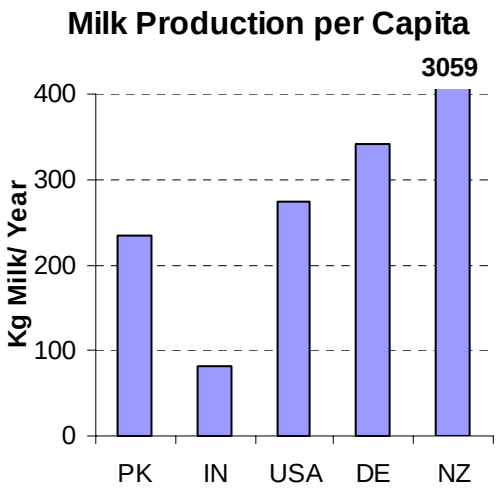

World Milk Production
Million Tons
120
105
90
75
60
45
30
15
0
287
PK
IN
USA
EU
Others


Dairy Farm Sizes
Animals/ Farm
35
30
25
20
15
10
5
0
3
2
88
236
PK
IN
USA
DE
NZ


Milk Yields (1997)
Kg/ Milch Animal/ yr
8000
7000
6000
5000
4000
3000
2000
1000
0
PK
IN
USA
DE
NZ


Number of Live Animals
Million Heads
100
90
80
70
60
50
40
30
20
10
0
220
Cattle
Buffaloes
PK
IN
USA
DE
NZ


Farm Gate Milk Prices
US$/ 100 Kg ECM
35
30
25
20
15
10
5
0
PK
IN
USA
DE
NZ


Milk Production per Capita
Kg Milk/ Year
400
300
200
100
0
3059
PK
IN
USA
DE
NZ

2.2 Recent Dairy Developments

Developments of Milk Production

From 1996 to 2002 milk production in Pakistan increased by 17 percent. Milk production from buffaloes increased by 20 percent while that from cattle rose by 11 percent.

Regional Shares of Milk Production

In 2002, Punjab maintains the same 70 percent share of the national milk production it had in 1996.

Development of Milk Yields

Pakistan has seen a slight increase in milk yields, both in buffaloes and cows. This is due to limited impact of breeding schemes through selection and artificial insemination, etc. Little attention has been paid to the improvement of local cattle, except for their use as a genetic resource pool for cross breeding with exotic dairy breeds for the supply of F1 crossbred cows. A local cattle breed of Sahiwal, Cholastani and Red Sindhi has practically disappeared in their pure form, which were quite adaptable to the local conditions. Sahiwal cows have produced up to 5000 kg of milk in one lactation (Sikka1931).

Crossbred is not a permanent solution to increase the milk yield in the country as the FI really shows improved performance in milk yield but Lateron as the exotic blood exceeds the level of 50% in F2 then it starts declining in terms of productivity and greater susceptibility to diseases and adaptability to climatic stress of heat and humidity.

Development of the Numbers of 'Dairy Animals'

In 2002, Pakistan had 15 percent more dairy animals than in 1996. The number of buffaloes increased by 18 percent while then number of local and crossbred cattle rose by 12 percent.

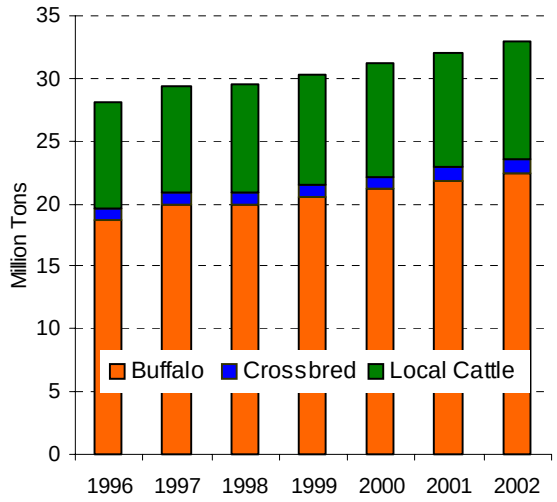
Development of Milk Prices

Nominal milk prices in Pakistan rose by 40 percent between 1996 and the first quarter of 2003. However, real milk prices have remained virtually unchanged with a slight drop by around 10% recorded in 1997, followed by an upward movement between 2000 and 2001.

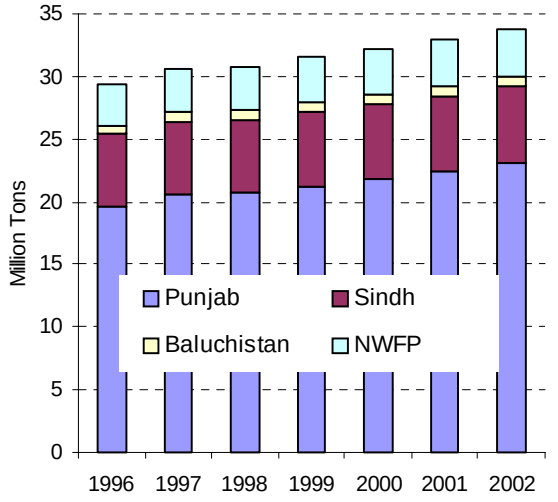
Explanations of variables; sources of data:

- **Buffalo:** Bubalus bubalis. The most common breed of buffalo is Nili Ravi which constitutes 76.7 percent of the total buffalo population in Pakistan.
- **Local Cattle:** These include Sahiwal, Cholistani, Dajal, Dhani, Rojhan. Sahiwal are a high yielding breed but the pure blood is diminishing due to cross breeding.
- **Crossbred:** Dairy animals with varying degrees of a highly productive dairy genetics. Australian Holstein Friesian with local Sahiwal and Cholistani.
- **Milk production:** FAO Agricultural Statistics; from http://www.fao.org ; checked on March 2003.
- **Regional Milk production:** Calculations from 'Cattle and Buffalo Development Punjab, 2002'.
- **Daily Milk Yields**: Calculations from 'Cattle and Buffalo Development Punjab, 2002'.
- **Number of Live Animals**: Calculations from 'Cattle and Buffalo Development Punjab, 2002'.
- **Milk Price Development:** Milk Market Survey. Done by the authors in April 2003.

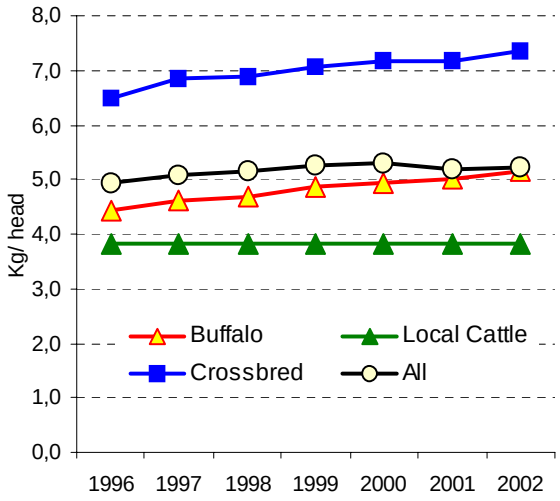
Milk Production



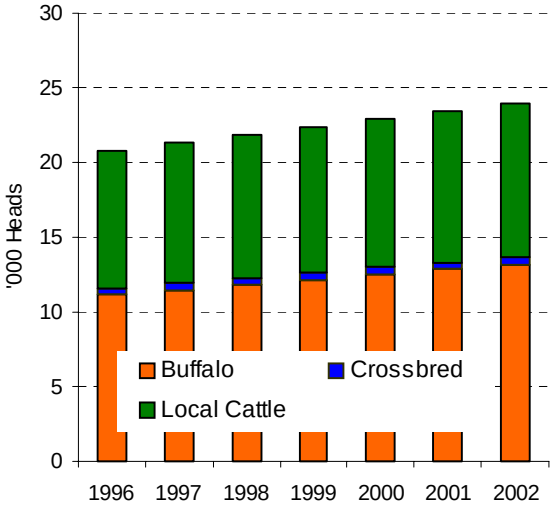
Milk Production by Regions



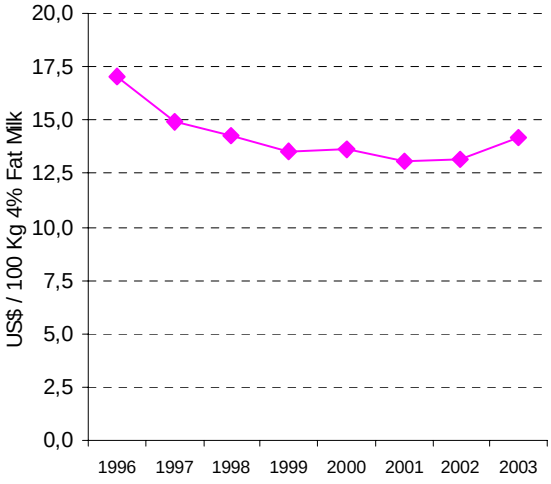
Daily Milk Yields



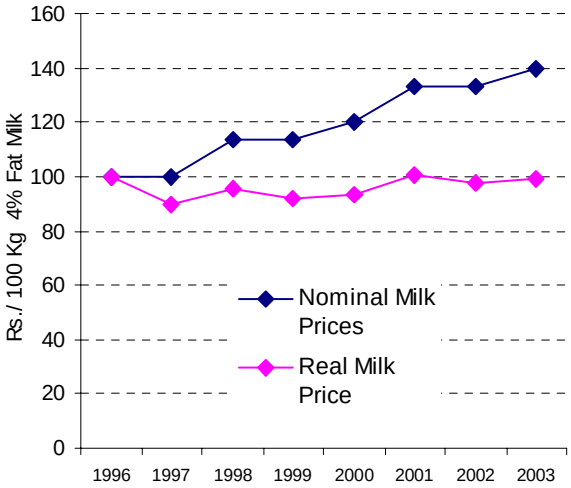
Number of Milch Animals



Milk Prices Developments in US$



Milk Prices Developments
(Indexed in Rupees)



2.3 Processing and Marketing Channels for Dairy Products

Only 40% of the milk surplus left from calves suckling, home consumption and indigenous home processing finds its way to the urban markets. Up to 15% milk is being wasted due to non-availability of proper cooling and storage mechanism. It is estimated that only about 2 percent of the milk in urban markets flows through formal processing channels while the remaining 98 percent is consumed as raw milk and informally marketed through local milkmen (Gawalla).

Village households sell part of their morning milk to either a milk center (majority of centers are being operated by a few large processing companies or some milk traders) or milkman. Usually these households consume most of their evening milk in the form of various value added products such as a butter oil (ghee), butter or yogurt and traditional drinks such as Lassie (drink prepared from fermented milk after removing cream). The surplus milk products are sold in the village or sold to the sweet makers in the cities.

Raw Milk

The more commercially oriented rural farms (those with more than 3 dairy animals) sell their surplus milk either to milkmen or deliver it to the village milk collection points of commercial processing companies. In contrast, commercial urban or peri-urban farms sell their milk directly to the consumers as the price that can be charged in the towns and cities is much more attractive.

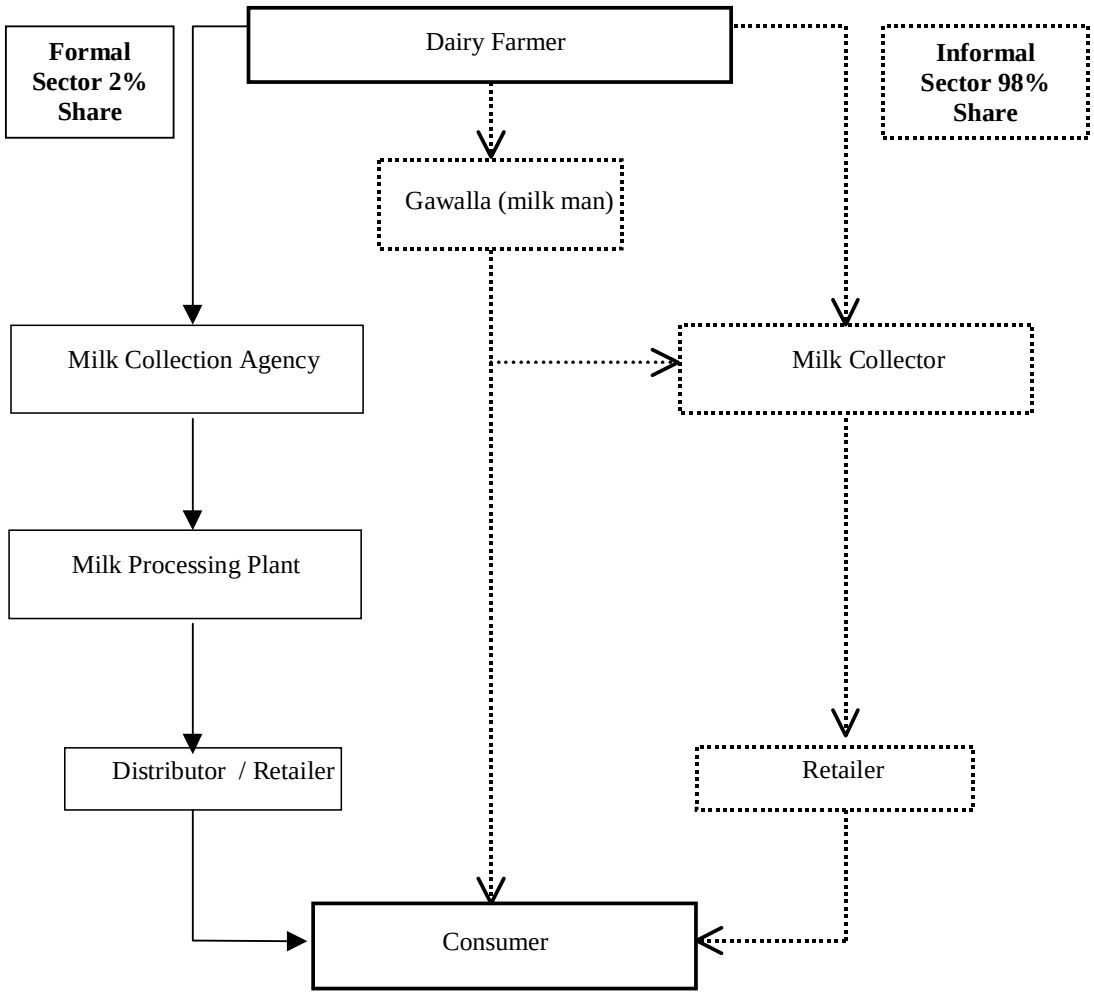
In Lahore, about 90 percent of the milk is sold through the Gawalla while only 9 percent of the city's milk consumption are handled through the formal distribution chain and sold as open pasteurized (loose form sold at milk retail shops as milk is kept in refrigerators), pasteurized pouch packed and carton packed milk (such as UHT Tetra pack and others).

Processed Milk

Processing of milk is done by the formal sector. Of the different types of processed liquid milk, pasteurized milk (both in loose form and plastic pouch packing) and UHT milk in tetra packs are by far the most popular products. Milk powder with different levels of fat is also produced. Yoghurt, butter, cheese and ice cream represent a small proportion of the processed dairy products.

The informal sector produces Lassie (a drink from boiled and/or raw milk), which is very popular in summer and is used as a thirst quencher. In winter, the most common indigenous milk products are boiled milk and sweets produced by condensing liquid milk, which is called Ghoyia (condensed milk with sugar). These products are produced by specialised milk shops in the cities and capture high prices.

Simplified Diagram of Flow Channels for Milk in Pakistan



Source: Strategy Development in Milk Production and Distribution (SMEDA Report, 2000)

3 ANALYSIS OF THE DAIRY SECTOR IN PUNJAB

3.1 Recent Dairy Developments in Punjab

Milk Production

Milk production in Punjab increased by 17 percent in the period from 1996 to 2002. Buffalo milk production increased by 18 percent while milk production from cattle rose by 17 percent. In general, most of this increase in milk production has been driven by an increase in animal numbers rather than by improvements in productivity.

Composition of the Dairy Herd

The number of buffaloes has increased by 18 percent between 1996 and 2002 while in the same period the number of crossbred and local cattle increased by slightly under 12 percent. The strong increase in animal numbers can partly be attributed to several years of crop failure, which encouraged farmers to switch to raising livestock as a risk management tool. The number of buffaloes has risen faster than that of cattle due to the traditional preference for high fat milk (up to 7 percent), which allows them for some cream to be skimmed off for other household uses.

The number of Indigenous cattle has also increased, despite their lower milk yields, due to their higher affordability and high adaptation to local conditions and practices.

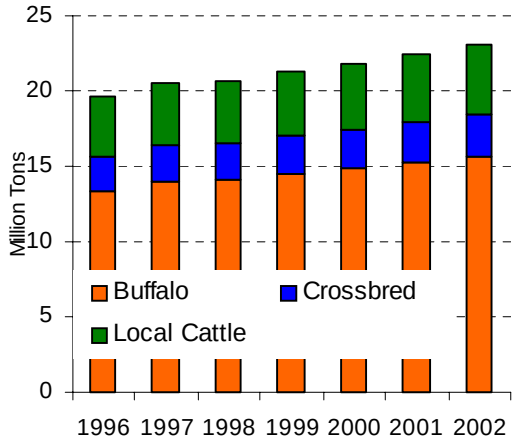
Development of Milk Yields

Milk yields have improved for all animal types since 1996 by between 5 and 13 percent. The improvements are mainly due to limited impact of breeding, improved management and feeding practices. These positive developments are supported by the increased demand of milk consumption on one hand and farmers awareness due to new limited market opportunities offered by few milk processing companies as they set up milk collection centers in few regions in Punjab. . Farmers are motivated to find ways to produce more milk whenever they find reliable buyers and obtain fair prices for their milk.

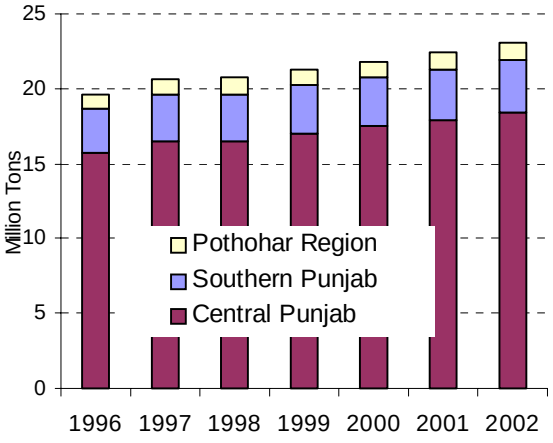
Explanations of variables; year and sources of data:

- **Local Cattle:** Dairy animas of local origin (Bos indicus), which have low milk yields but are well adapted to local conditions.
- **Crossbred:** Dairy animals with varying degrees of a highly productive dairy breed (Bos taurus; usually Holstein and Brown Swiss) and one of the many local cattle breeds.
- **Milk Production**: Calculations from 'Cattle and Buffalo development Punjab', Pakistan – German Technical Co-operation, Planning & evaluation Directorate, Punjab Livestock and Dairy Development department.
- **Development of Milk Yields:** Calculations from 'Cattle and Buffalo development Punjab'.
- **Composition of the Dairy Herd**: Calculations from 'Cattle and Buffalo development Punjab'.

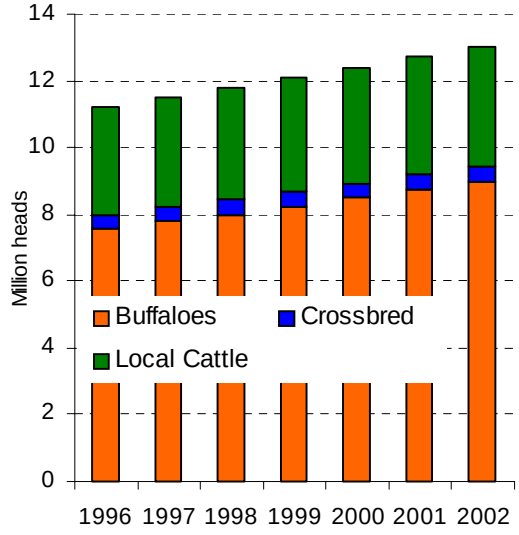
Punjab Milk Production



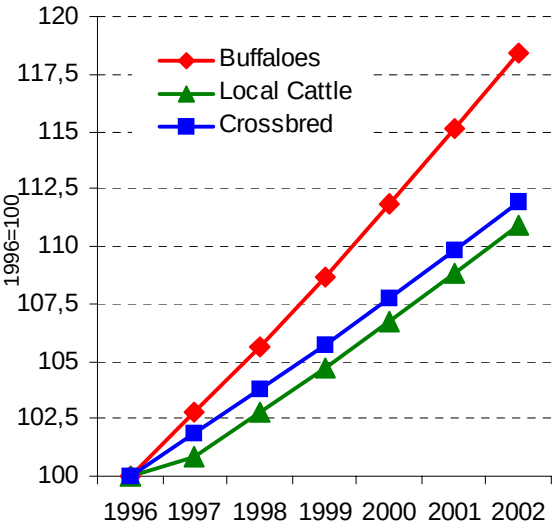
Punjab Milk Production by Regions



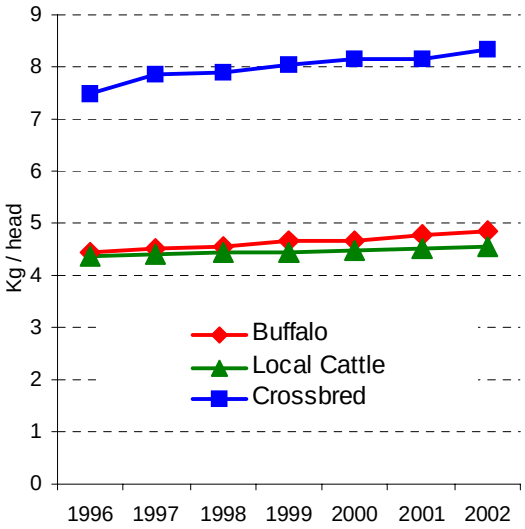
Composition of the Dairy Herd



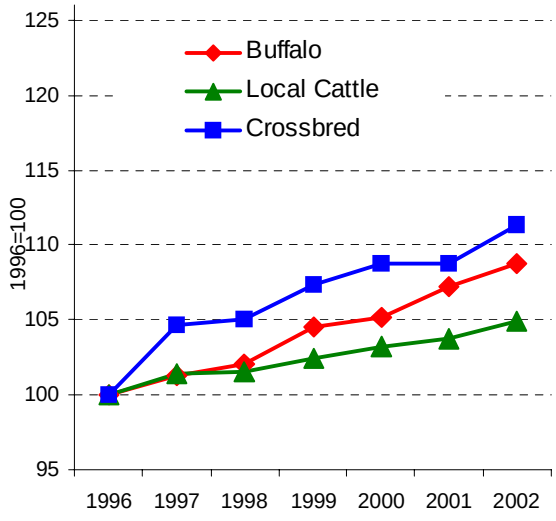
Changes in Herd Composition



Daily Milk Yields



Growth of Milk Yield



3.2 Natural Conditions and Farm Structure

The selected rural farms are located in the district of Layyah, Punjab. The peri-urban farm lies in the vicinity of the major city of Lahore (app. 5 million Inhabitants).

All selected farms represent 'typical' production systems and account for the bulk of milk produced in the province of Punjab.

Natural Conditions

Temperature

The climatic conditions of both selected sites, Lahore and Layyah districts, display similar patterns of moderate and high temperatures during the year. The temperature in summer is relatively higher in the Layyah district as it is close to the Thal Desert, which heats up during the day and cools down in the night.

Rainfall

Summer represents the rainy season in both areas. However, the district of Lahore receives almost twice the rainfall as Layyah.

Both districts have good irrigation systems, which make agricultural activities relatively independent from rainfall.

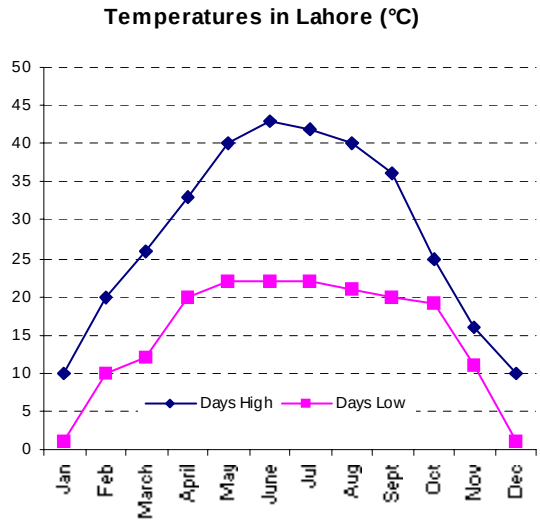
Farm Structure

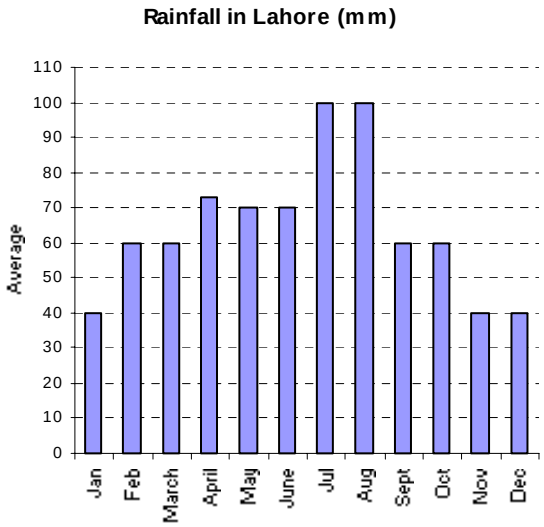
In Pakistan, classification of farms based on size of landholding shows that more than 80 percent of farms have less than 5 hectares of land. Most of these small farmers depend on livestock farming as a parallel activity to crop farming. About 6 percent farms have land holdings of more than 20 hectares. Most these big farms are owned by absentee landlords who don't work on the farm, their farms being managed by tenants.

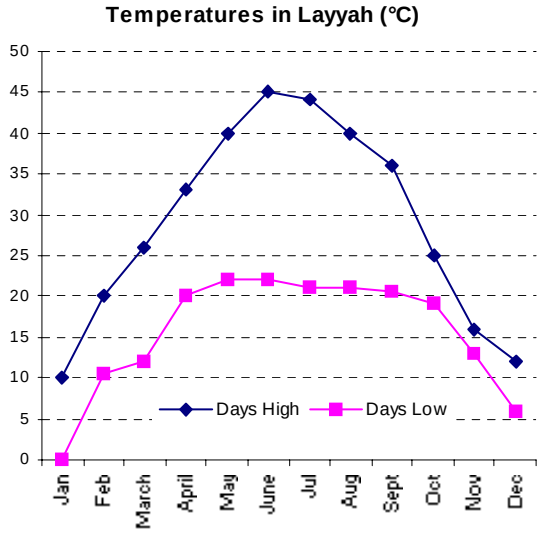
Table 1 on the next page gives a simplified overview of land holding structure in Pakistan.

Explanations of variables; year and sources of data:

- **Temperature**: Pakistan Meteorological Department Weather database 2002.
- **Rainfall**: Pakistan Meteorological Department Weather database 2002.
- **Farmland Structure**: Pakistan Agricultural Statistics, 1999-2000.







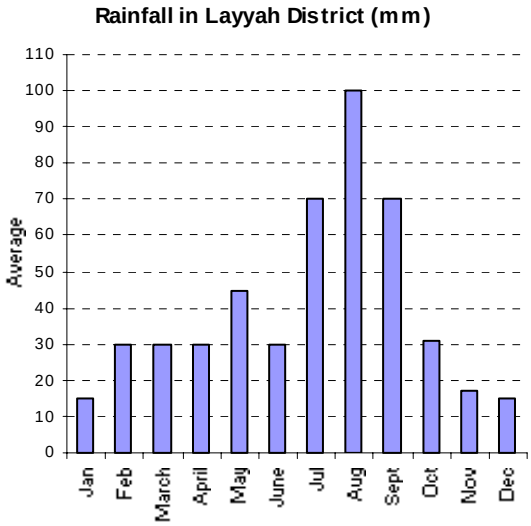


Table 1: *Farm Structure in Pakistan*

Farm Size (Ha)	Farms		Farm Area		Av. Farm Size
	Number	%	Hectare	%	Hectare
Private Farms	5,070,963		1,914,9673		3.78
Government Farms	149		103,035		-
All Farms	5,071,112	100	19,252,672	100	-
Under 0.5	678,538	13.4	193,126	1	0.3
0.5- <1.0	689,233	13.6	510,397	3	0.7
1- <2	1,036,286	20.4	1,446,796	8	1.4
2- <3	841,295	16.6	1,973,800	10	2.3
3- <5	857,387	16.9	3,309,432	17	3.9
5- <10	623,110	12.3	4,134,346	22	6.6
10- <20	237,929	4.7	3,032,872	16	12.7
20- <60	91,831	1.8	2,613,767	14	28.5
More than 60	15,354	0.3	1,935,101	10	126.0

Source: Pakistan Agricultural Statistics, 1999-2000.

3.3 Description of the 'Typical' Dairy Farms in Punjab

Four typical milk production systems have been identified in the province of Punjab by IFCN. One farm of each type has been analyzed for this study. In the following part each farm is briefly described while more details especially about the dairy production systems can be found in the table on the next page.

1-cow farm (PK-1)

Location: Land less household located in the rural area.

Activities: The farm keeps 1 buffalo and utilises crop residues acquired from other farmers fields (most of the time weeds and wild grasses)for feeding. The family consumes 73 percent of the milk produced while the surplus is sold to the local milkman. The farmer raises replacement heifers. The main source of income is off-farm employment, mostly as seasonal worker on larger crop farms in the region or taking contract of manual crop harvesting, e.g. in this situation they are paid in terms of wheat grains for harvesting per hectare of wheat (in the study are the prevailing rate is 250 Kg grains for harvesting one hectare of wheat crop).

3-cow farm (PK-3)

Location: A farm in a rural-area with 3 ha of irrigated land (1 owned and 2 rented).

Activities: The farm keeps 3 buffaloes and delivers 80 percent of the milk produced to the nearest milk collection point. Crop residues and fodder, both grown on-farm provide the feed basis. Lactating cows are supplemented with cottonseed cake. The farm raises its own replacement heifers. Besides dairy farming, off-farm employment and production of cash crops constitute major income sources.

10-cow farm (PK-10R)

Location: A farm in a rural area with 6 ha of irrigated land.

Activities: The farm keeps 10 buffaloes. The milk is sold to the milk collection point, twice a day. The rations consist of green fodder grown on the farm throughout the year, concentrate by-products like cottonseed cake/rape seed/wheat bran, and a compound (balanced) feed. The farm raises its own replacement heifers. Dairy and crop farming are the only income sources and make similar contributions to the total farm returns. (No off-farm employment).

10-cow farm (PK-10U)

Location: Landless dairy farm, near Lahore.

Activities: The farm keeps 10 "dairy animals" (8 buffaloes and 2 crossbred cows). The farm purchases all the feed (green fodder and compound feed). The milk is sold directly to the consumers via home delivery. Sources of income are: dairy farming and one member of the household is employed.

Farm	Units	PK-1	PK-3	PK-10R	PK-10U
Land Owned	ha	no land	1	6	no land
Land Rented		-	2	-	-
Dairy Enterprise					
Milk Animals	no.	1	3	10	10
Breed	description	1 Buffalo	3 Buffaloes	10 Buffaloes	8 Buffaloes + 2 Crossbreds
Liveweight	kg	500	500	600	600
Milk yield	kg ECM/cow	1379	1943	2257	2482
Fat and protein content	%	6% / 3.5%	6% / 3.5%	6% / 3.5%	5.8% / 3.5%
% milk sold	%	27%	78%	90%	93%
Land use Dairy enterprise					
Land use for dairy	ha	-	0.64	14565,00	-
Milk produced per ha	Kg ECM/ ha	-	9109	15495	-
Stocking rate	LU / ha	-	*** 9	*** 13	-
Labour					
Full time employees	persons	0	0	1	2
Share of family labour	% of total	100%	100%	52%	15%
Hours per milking cow	h / cow/ yr	1401	1050	686	815
Buildings					
Housing type	description	Mud+bricked house; thached roof.	Bricked house; thached roof	Bricked shed, mangers; tiled roof.	Concrete shed with bricked floors
Building Built	year	1990	1995	1996	1998
Milking					
Milking system	description	hand	hand	hand	hand
Calves/ Animal/ Year	head	0.75	0.91	0.91	0.98
Length of lactation	days	280	280	290	290
Collection Centre	km (far)	3	2	3	5
Herd management					
Seasonality	yes/ no	yes	yes	no	no
Calving season	months	Aug -March	Aug -March	Aug -March	Aug -March
Dry period	months	6	4	4	3
Dry off by medication	yes / no	no	no	no	no
Feeding times	per day	3	3	3	3
Death rate	% cows	2	2	2	2
Cow Culling rate	% / year	15	15	10	20
Feeding					
Feeding systems	description	stall fed	stall fed	stall fed	stall fed
Roughage feed source	description	Fodder * + wheat straw	Fodder * + wheat straw	Fodder * + wheat straw	Fodder * + wheat straw
Concentrates fed	description	None	CSC**	CSC**/ compound feed	CSC**/ compound feed
Concentrate use in total	t per cow	0	0.31	0.47	0.81
Concentrate input	g / kg ECM	0	160	208	328
Calf rearing					
Death rate of calves	% calves	20%	20%	20%	20%
Weaning period	months	6	4	4	1

Notes: * Fodder crops refers to Jowar (maize), Millets, and Berseem (and weeds and sugar cane tops for PK1)

** CSC means Cottonseed cake; Compound feeds refer to commercial balanced feed mixtures.

*** Stocking rates include all animals on the farm (as Live Unit equivalent) and the land allocated to the dairy ONLY. As an environmental indicator, these rates would be significantly lower since manure is used on the whole farmlands or sold out.

3.4 Farm Comparison: Household Approach

Size of the Household and Labour Utilisation

The farm families are composed of 5 to 8 members, which is typical in the region. The land-less households (PK-1 and PK-10U) allocate larger proportions of their family labour to off-farm work (about 70 percent) than the two households that own land. Several family members of PK-1 work as labourers on larger crop farms nearby whereas one member of PK-10U has an office job in the city of Lahore. PK-3 allocates about 35 percent of its family labour to off-farm employment while PK-10R employs all of its labour on the farm.

Household Income Levels

The estimate of household income presented on the next page includes the net cash farm income, the off-farm salary and the value of manure and milk used in the household. The annual incomes vary between US$ 654 (PK-1) and US$ 2,283 (PK-10R). The higher income of PK-10R compared with PK-10U might indicate that owning 6 ha of land for crop production has a higher impact on household income than having a job in Lahore.

Household Income Structure

Non-cash benefits are more relevant for households without land (over 18 percent of their total incomes) than for those with land.

When non-cash benefits are excluded, the farm incomes account for 65 and 85 percent of the household incomes for the two farms with land (PK-3 and PK-10R). For land less households, the net cash farm incomes constitute 12 and 53 percent of the household incomes (PK-1 and PK-10U).

Household Living Expenses

The family living expenses increase with increasing farm/herd size and differ between farm locations, rural vs. urban. All farms are able to cover the family living expenses, under the assumed framework. It should be mentioned that the family living on the PK-1 on 654 US$/year (93 US$/person/year) is in 'very poor' living conditions.

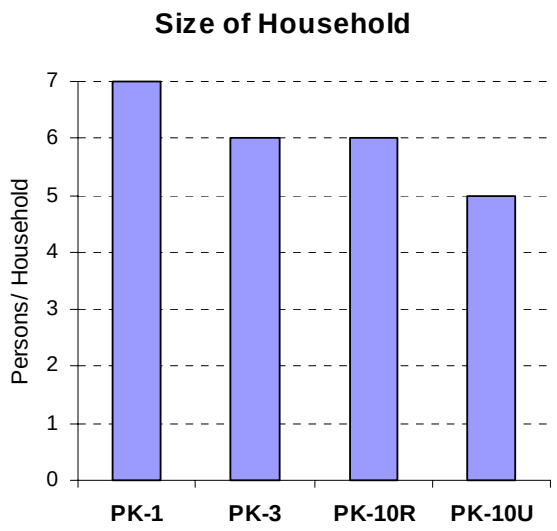
Household Equity Growth

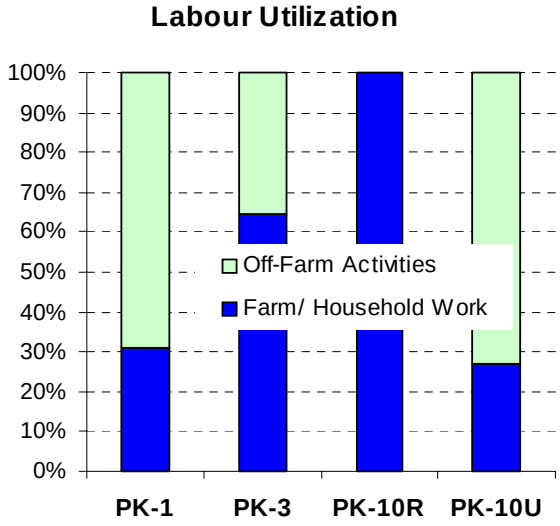
When living expenses are subtracted from total household income, all farm households make a surplus ranging from US$ 140 to US$ 1,160 per year.

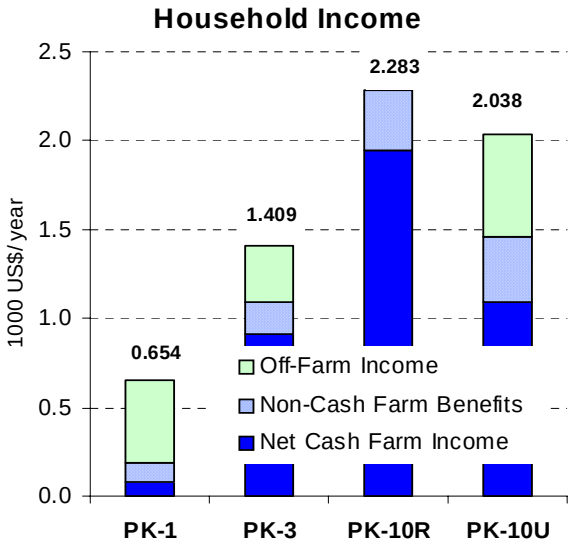
These surpluses might be used in various ways such as marriage of children, cases of emergencies, extension of the family housing, purchasing household items, etc.

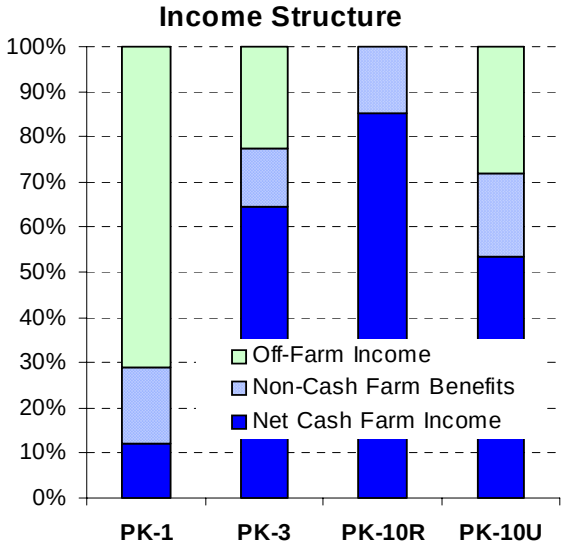
Explanations of variables; year and sources of data:

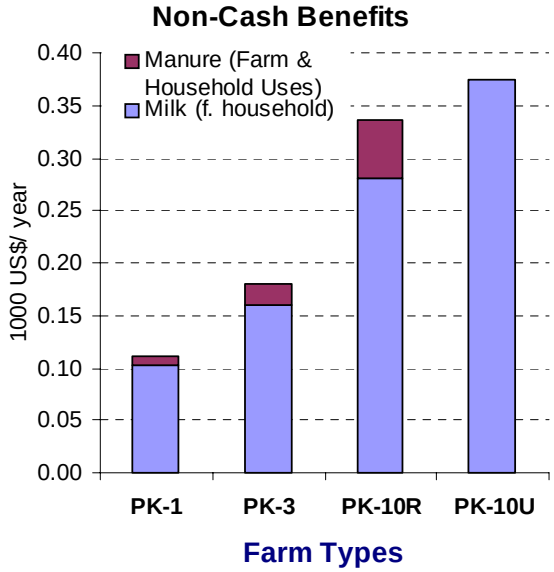
- **Size of the household**: All people living together
- **Labour utilisation:** All family labour used to generate income
- **Household income:** Includes cash and non-cash incomes from farm and off-farm activities
- **Off-farm incomes**: Include all salaries for all family members
- **Non-Cash Benefits:** Value of manure (6 US$/animal/year)& milk used by the family
- **Net cash farm income:** Total farm receipts minus total farm expenses
- **Household living expenses:** Minimum annual cash expenses to maintain current living conditions.
- **Exchange rate used**: 1 US$ = 62.26 PK Rupees.
- **Sources of Data:** IFCN data collection based on expert estimations and statistics for year 2002.

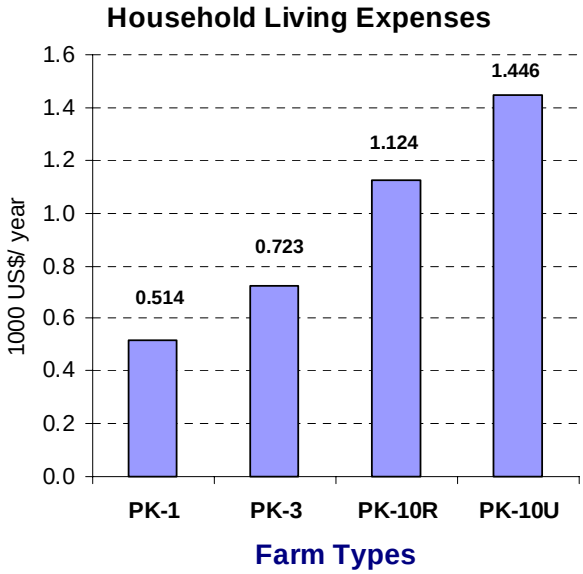

Size of Household
Persons/ Household
0
1
2
3
4
5
6
7
PK-1
PK-3
PK-10R
PK-10U


Labour Utilization
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Off-Farm Activities
Farm/ Household Work
PK-1
PK-3
PK-10R
PK-10U


Household Income
1000 US$/ year
0.0
0.5
1.0
1.5
2.0
2.5
0.654
1.409
2.283
2.038
Off-Farm Income
Non-Cash Farm Benefits
Net Cash Farm Income
PK-1
PK-3
PK-10R
PK-10U


Income Structure
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Off-Farm Income
Non-Cash Farm Benefits
Net Cash Farm Income
PK-1
PK-3
PK-10R
PK-10U


Non-Cash Benefits
1000 US$/ year
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Manure (Farm & Household Uses)
Milk (f. household)
PK-1
PK-3
PK-10R
PK-10U
Farm Types


Household Living Expenses
1000 US$/ year
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0.514
0.723
1.124
1.446
PK-1
PK-3
PK-10R
PK-10U
Farm Types

3.5 Farm Comparison: Whole Farm Approach

Farm Returns

The farm returns range between US$ 236 and US$ 6,400 per year. The low annual return of PK-1 (236 US$) is mainly due to the low milk volume sold (27 percent of its milk production). The difference in farm returns between farms PK-10R and PK-10U seems to be quite low considering the large differences in crop returns. This can be explained partly by the higher volume of milk sold by PK-10U (over 2 tons more), and the higher milk price obtained (1.8 times as high).

Other farm returns stem from selling goats, chickens and eggs by the two smaller farms.

Net Cash Farm Income (NCFI)

The net cash farm income mainly follows the level of farm returns. However, the NCFI of PK-10R is 1.8 times that of PK-10U, despite farm returns being similar. This dramatic discrepancy is a result of the higher profitability per kg milk of PK-10R.

PK-1 has a very low net cash farm income of US$ 79 per year. This is a result of the low proportion of milk sold coupled with the lower milk price achieved.

Farm Assets

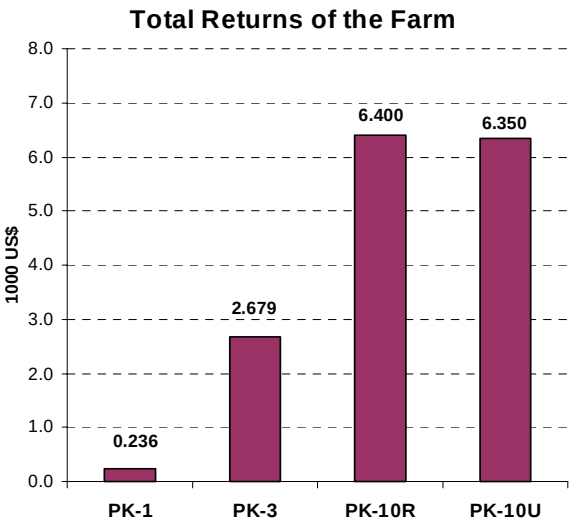
On a whole farm basis, land is the most important asset representing over 65 percent of the assets of the two farms owning land (PK-3 and PK-10R). Land prices for the two farms are around US$ 5,900 per hectare of arable land. The very high asset value of PK-10R is due to the 6 ha of owned arable land and the high value of machinery.

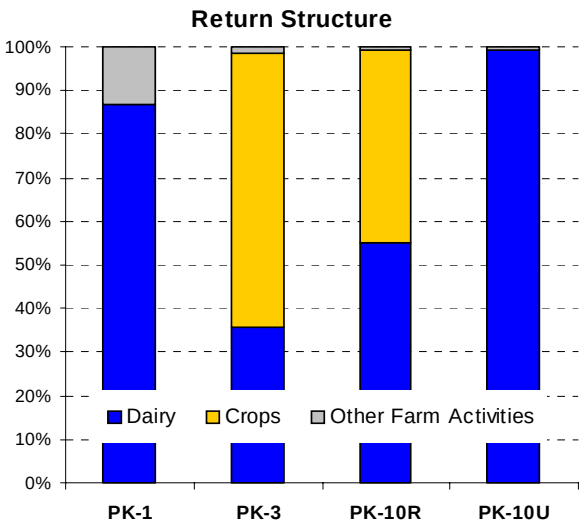
The farms without land (PK-1 and PK-10U) have a much lower capital stock. In these farms the main assets are the livestock, constituting 59 percent of the asset value for PK-10U; and machinery, buildings and cash in hand which make up 55 percent of the asset value of PK-1.

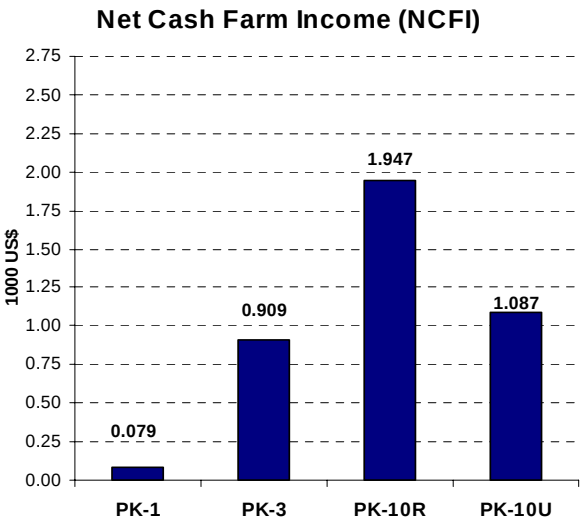
PK-10R's very high assets are mostly explained by having, first, 6 ha of owned arable land and very high machinery value. The other farm with land (PK-3) owns only one ha.

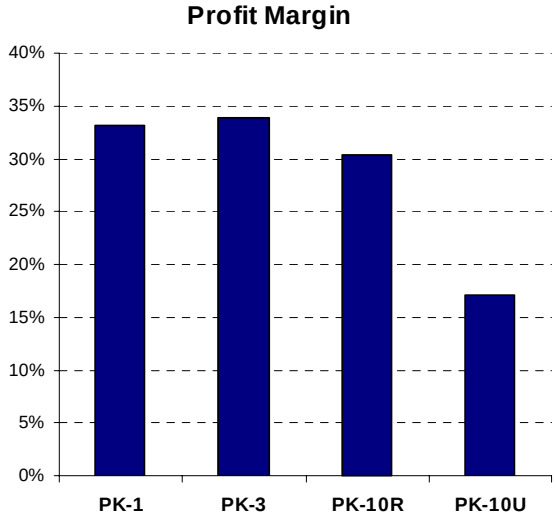
Explanations of variables; and sources of data:

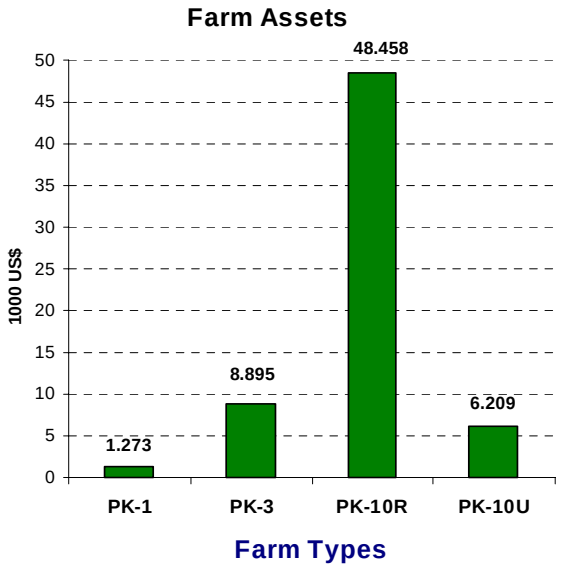
- **Total Returns:** All cash receipts minus the balance of inventory (for example livestock).
- **Returns Dairy:** Milk, cull cows, heifers, calves, sale of manure, etc.
- **Cash Crops:** Selling surplus crops like rice, wheat, etc.
- **Other Farm Activities (Returns):** Sales of goats, chickens, and eggs.
- **Net Cash Farm Income (NCFI):** Cash receipts minus cash expenses of the farm
- **Profit Margin:** Net cash farm income divided by total farm returns.
- **Farm Assets**: Includes all assets related to the farm (land, cattle, machinery, building, etc.)
- **Others (in Assets Structure)**: Includes all machinery, building, and cash in hand, etc.
- **Other Animals**: Refers to goats, sheep and poultry owned and held on the farm.
- **Exchange rate used**: 1 US$ = 62.26 PK Rupees.
- **Sources of Data**: IFCN data collection based on expert estimations and statistics for year 2002.

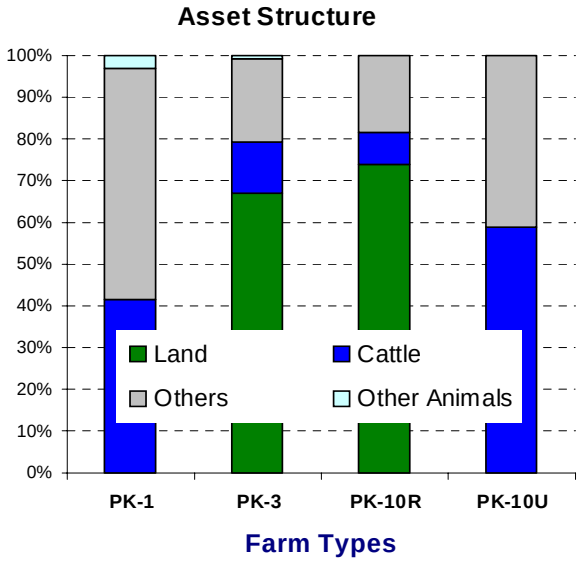

Total Returns of the Farm
1000 US$
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.236
2.679
6.400
6.350
PK-1
PK-3
PK-10R
PK-10U


Return Structure
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Dairy
Crops
Other Farm Activities
PK-1
PK-3
PK-10R
PK-10U


Net Cash Farm Income (NCFI)
1000 US$
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0.079
0.909
1.947
1.087
PK-1
PK-3
PK-10R
PK-10U


Profit Margin
40%
35%
30%
25%
20%
15%
10%
5%
0%
PK-1
PK-3
PK-10R
PK-10U


Farm Assets
1000 US$
50
45
40
35
30
25
20
15
10
5
0
1.273
8.895
48.458
6.209
PK-1
PK-3
PK-10R
PK-10U
Farm Types


Asset Structure
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Land
Cattle
Others
Other Animals
PK-1
PK-3
PK-10R
PK-10U
Farm Types

3.6 Farm Comparison: Dairy Enterprise Approach

Cost of Milk Production

PK-3 and PK-10R (farms with land) have the lowest costs of milk production of US$ 11.65 and 8.50 per 100 kg ECM. Costs of PK-1 and PK-10U are US$ 18.00 and 18.65 per 100 kg ECM respectively. The main reasons for these high production costs are high labour costs for PK-1 and high feed costs for PK-10U.

Return Structure

The returns from milk production range from US$ 15.5 to 25.5 per 100 kg milk. Differences in returns can be explained by the marketing system and the proximity to an urban centre (direct marketing for PK-10U vs. selling to the milkman by rural PK-1). Non-milk returns are a result of selling livestock and manure (shown as Other Returns).

Cost Structure

In the smaller farms, opportunity costs represent the main cost component. For PK-1 only about 22 percent of the production costs are cash expenses. Although PK-3 has the cost of renting land and high costs for 'means of production' (fuel, fertilizer, etc), its high use of crop residues as animal feed keeps its cash costs the lowest of the four farms. The larger farms (especially PK-10U) employ workers, use more purchased feed instead of crop residues and other inputs that increase the cash costs significantly (up to almost double those of PK-3).

The observed differences in production costs are significant and basically the result of differences in milk yields and labour costs between the first three farms and of the high feed and labour costs incurred by farm PK-10U. Farm PK-10R incurs about 20 percent of the labour costs of PK-1 and about 25 percent of the feed costs of PK-10U per 100kg ECM.

Farm Income

All farm types cover their costs from the profit and loss account and produce a farm income. The dairy income ranges from about US$ 10 (for PK-1) to US$ 6 per 100 kg (PK-10U).

Profit margins are high on all farms. However, the rural farms achieve profit margins between 55 and 65 percent. This is mainly because they don't have to pay (cash) for their high labour cost (PK-1) and most of their feed is provided by their own crop residues (PK-3 and PK-10R). The urban farm only achieves a profit margin of 25 percent because this farm is forced to purchase all its feed.

Entrepreneurial Profit and Return to Labour

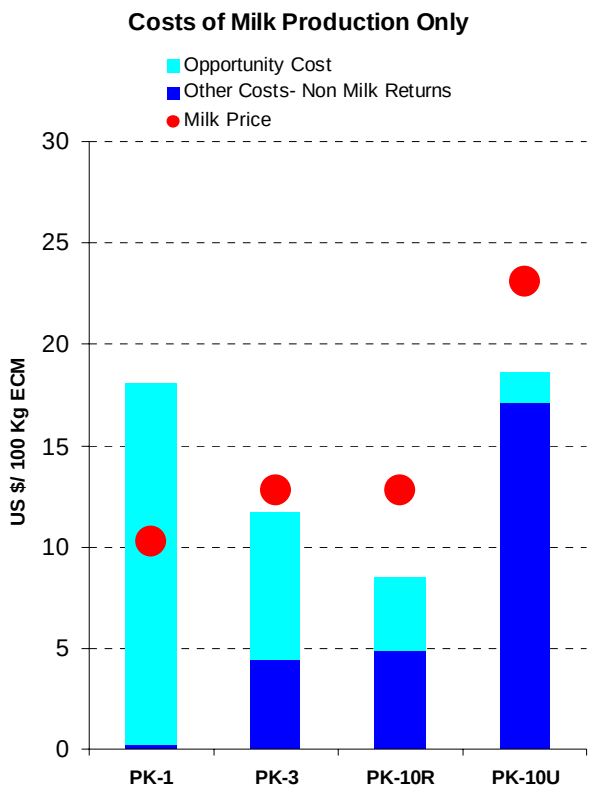
Only the smallest farm, PK-1, fails to cover its full economic costs and to generate an entrepreneurial profit. The other three farms produce a profit of US$ 1.14 to 4.43 per 100 kg milk. Likewise, with the exception of PK-1, all farms have higher returns to the labour used in the dairy enterprise than the wage level prevailing in the area.

Conclusions for the Smallest Farm Type

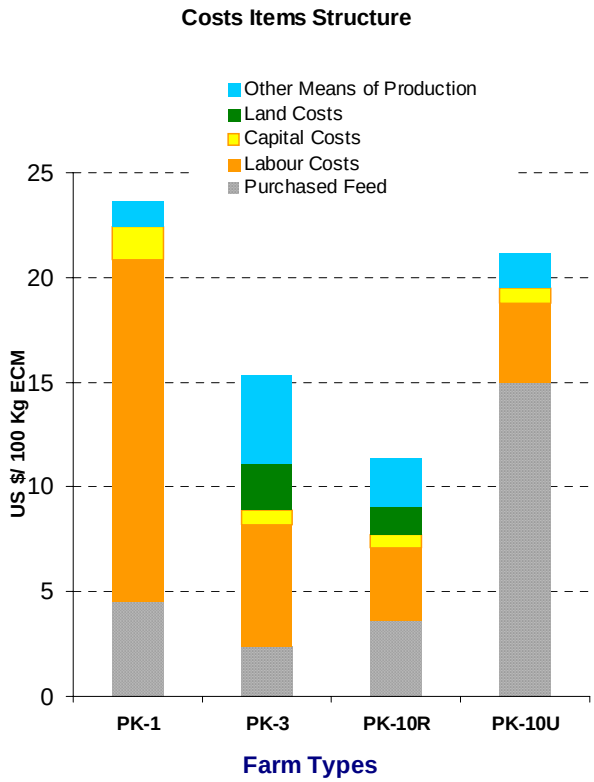
Without major improvements, farm type PK-1 will have difficulties in the long run to compete with other domestic and foreign milk producers. As in most other countries, the farm family will only keep their cows as long as alternative employment opportunities (0.16 US$/hour) are not available.

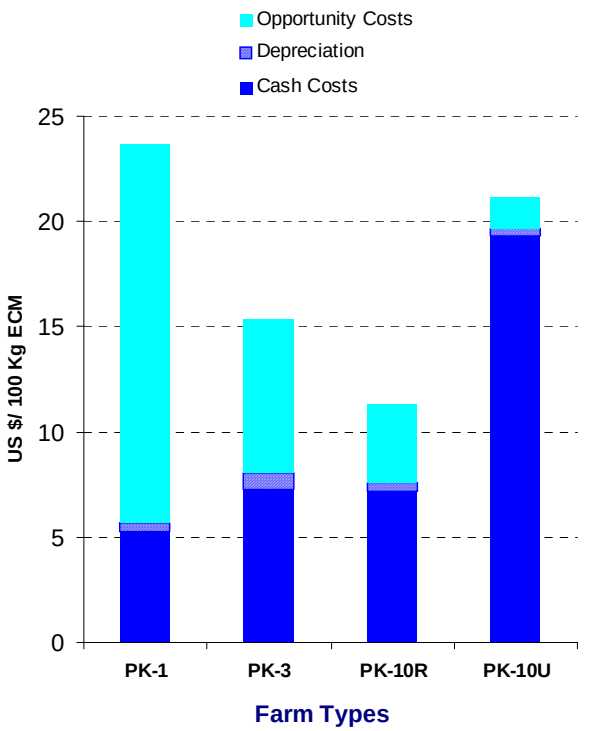
Explanations of variables; year and sources of data:

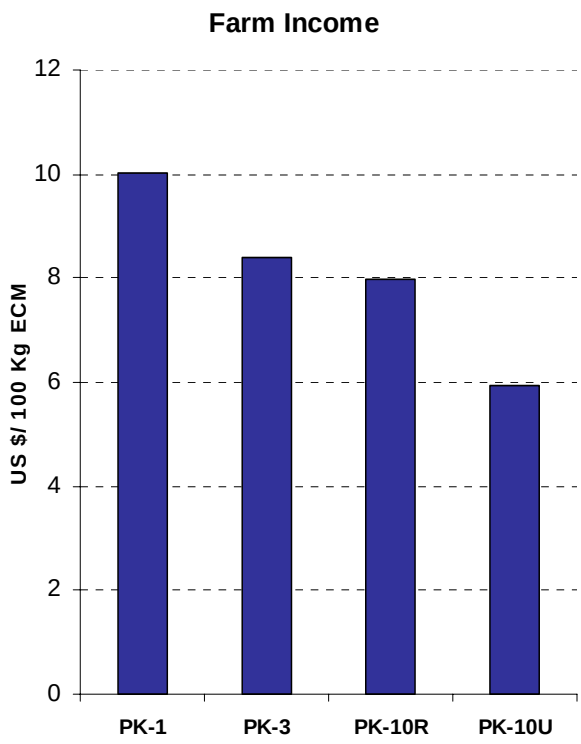
Explanations Variables and IFCN method: s. Annex 2 and 3
Other returns: Value of sold-out farm manure from the dairy enterprise.
Sources of Data: IFCN data collection based on expert estimations and statistics, year 2002**.**

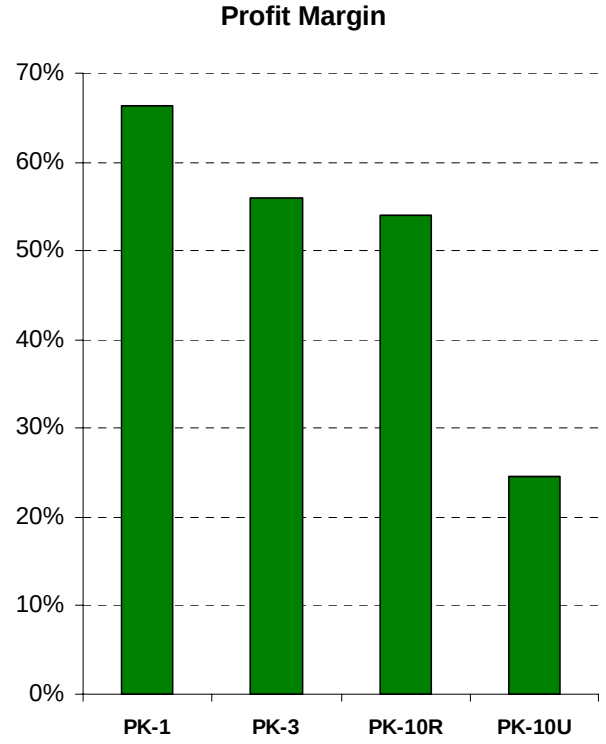

Costs of Milk Production Only
Opportunity Cost
Other Costs- Non Milk Returns
Milk Price
US $/ 100 Kg ECM
0
5
10
15
20
25
30
PK-1
PK-3
PK-10R
PK-10U

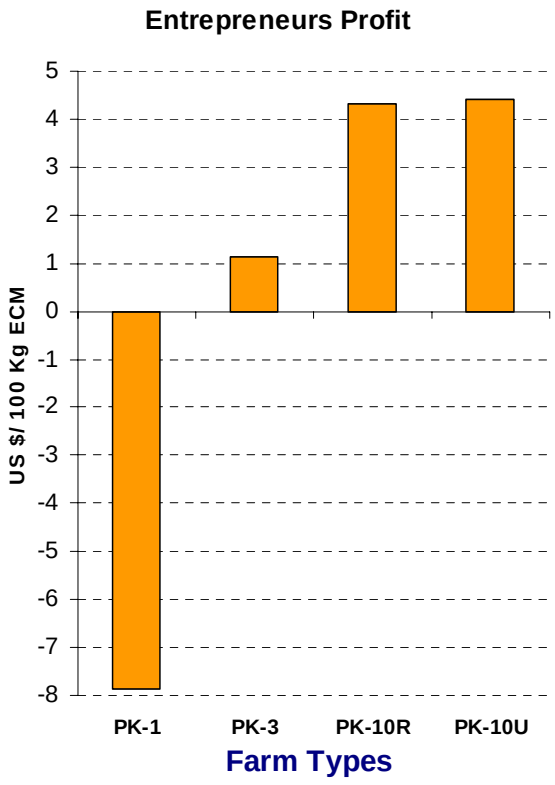

Return Structure
Cattle Sales
Other Returns
Milk Returns
US $/ 100 Kg ECM
0
5
10
15
20
25
30
PK-1
PK-3
PK-10R
PK-10U


Costs Items Structure
Other Means of Production
Land Costs
Capital Costs
Labour Costs
Purchased Feed
US $/ 100 Kg ECM
0
5
10
15
20
25
PK-1
PK-3
PK-10R
PK-10U
Farm Types

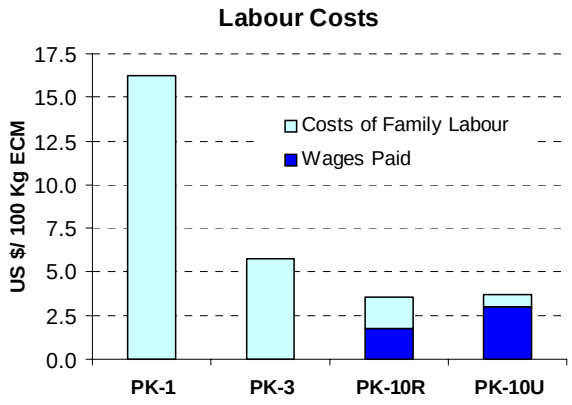

Cash/ Non-Cash Cost Structure
Opportunity Costs
Depreciation
Cash Costs
US $/ 100 Kg ECM
0
5
10
15
20
25
PK-1
PK-3
PK-10R
PK-10U
Farm Types

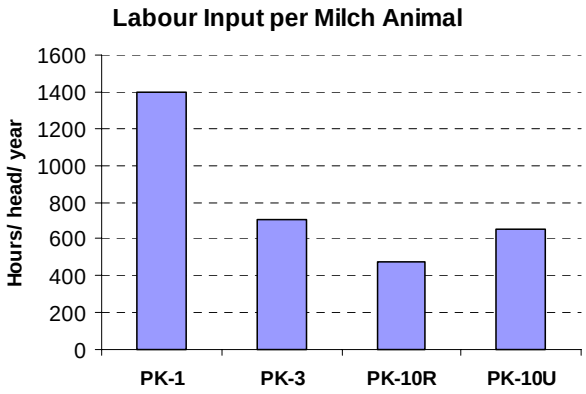

Farm Income
US $/ 100 Kg ECM
12
10
8
6
4
2
0
PK-1
PK-3
PK-10R
PK-10U

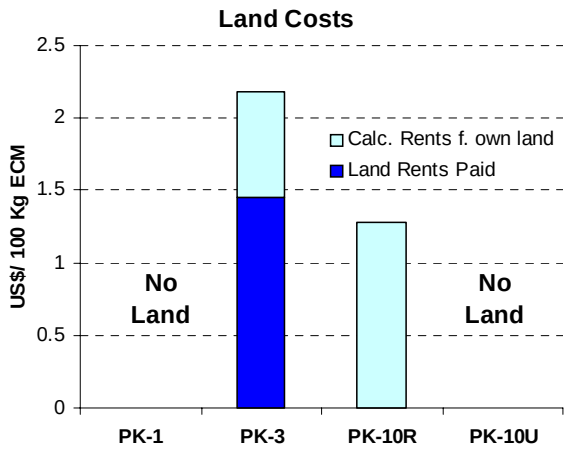

Profit Margin
70%
60%
50%
40%
30%
20%
10%
0%
PK-1
PK-3
PK-10R
PK-10U

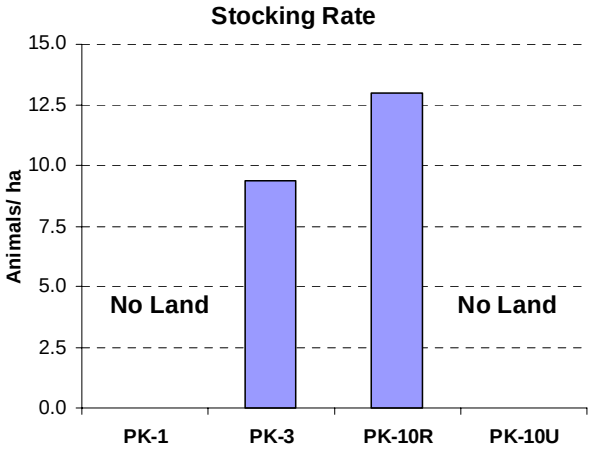

Entrepreneurs Profit
US $/ 100 Kg ECM
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8
PK-1
PK-3
PK-10R
PK-10U
Farm Types

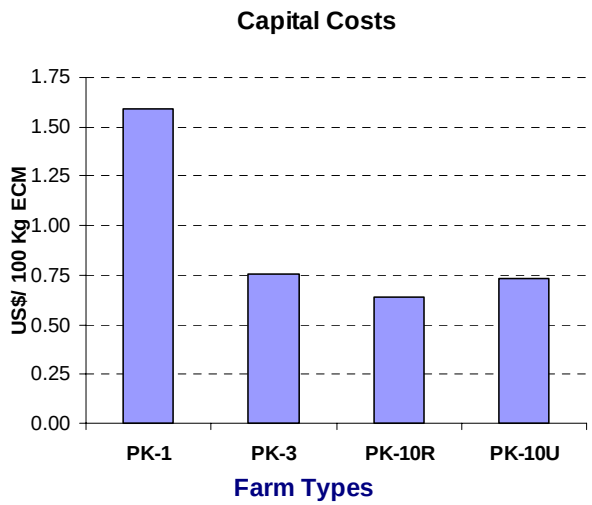

Return to labour
US$/ hr
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Wage Level
Return To Labour
PK-1
PK-3
PK-10R
PK-10U
Farm Types

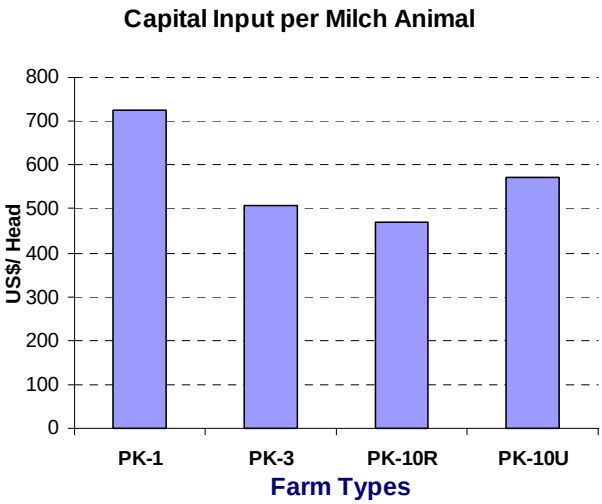

Labour Costs
US $/ 100 Kg ECM
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
Costs of Family Labour
Wages Paid
PK-1
PK-3
PK-10R
PK-10U


Labour Input per Milch Animal
Hours/ head/ year
1600
1400
1200
1000
800
600
400
200
0
PK-1
PK-3
PK-10R
PK-10U


Land Costs
US$/ 100 Kg ECM
2.5
2
1.5
1
0.5
0
Calc. Rents f. own land
Land Rents Paid
No Land
No Land
PK-1
PK-3
PK-10R
PK-10U


Stocking Rate
Animals/ ha
15.0
12.5
10.0
7.5
5.0
2.5
0.0
No Land
No Land
PK-1
PK-3
PK-10R
PK-10U


Capital Costs
US$/ 100 Kg ECM
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
PK-1
PK-3
PK-10R
PK-10U
Farm Types


Capital Input per Milch Animal
US$/ Head
800
700
600
500
400
300
200
100
0
PK-1
PK-3
PK-10R
PK-10U
Farm Types

3.7 Margins in the Dairy Chain: Farmer to Consumer

In this chapter, the margins in the dairy chain for liquid milk in Lahore, Punjab, are analyzed. For reasons of practicality and comparability among marketing channels, estimates are based on the assumption that each dairy channel buys milk with a fat content of 6 percent, processes it into the most popular liquid milk product, without adding any other ingredients (i.e. water, milk powder, etc.), and sells the liquid milk and cream if the latter is extracted.

Although there is a strong value adding business for both fresh milk and cream in Punjab, this part of the dairy chain is out of the scope of this analysis. Therefore, these dairy chain calculations should be seen as an exploratory exercise intended to support other sections of this study.

The Liquid Milk Products and Marketing Channels

Pasteurized, 3.5%: Processors buy 6% fat milk and sell at 3.5%, pasturized and unpacked.

UHT, 3.5%: Processors buy 6% fat milk and sell at 3.5% in tetra pack cartons.

Milkman, 4.5%: Private persons collect 6% fat milk and home delivers 4.5% fat milk

Direct sale, 6%: A dairy farm like PK-10U home delivers milk with 6% fat.

The pasturized and UHT milk represent the formal sector while the other liquid milk types are marketed through the informal channels.

Input Costs for the Dairy Chains (Liquid Milk / Cream)

The farmer milk prices range from US$ 0.14 to 0.23 per kg of 6 percent fat milk. The milkman pays the lowest milk price to farmers, while the highest price is obtained by directly selling to end customers at the farm gate.

Returns to the Dairy Chains (Liquid Milk / Cream)

The average consumer prices paid for the milk and cream produced from the initial kg of 6 percent milk amount to US$ 0.42 and 0.26 in the formal and informal sectors respectively. This higher price charged by the formal sector is needed to cover the cost of milk pasteurization and convenient packaging (milk shelf life extended by 3-4 weeks for UHT milk).

Margins (Output - Input value)

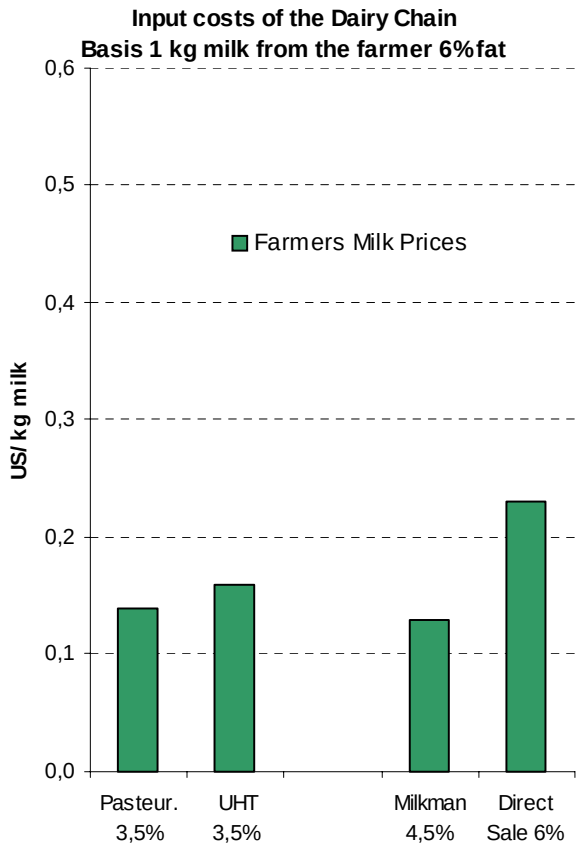
The formal sector has over three times the average margin of the informal sector (US$ 0.27 and 0.09 per kg). The margins of processing and retailing vary between US$ 0.06 and 0.36 per kg milk. Farms selling their milk directly have the lowest margin, as they do not participate in the “cream business”. UHT milk has a margin, which is comparable to that in Europe (US$ 0.3 – 0.5 per kg).

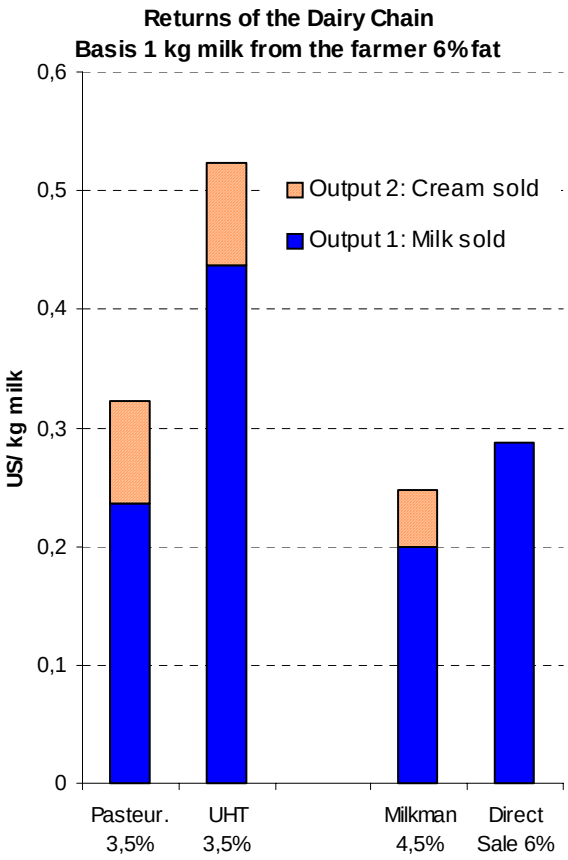
Farmers’ Shares

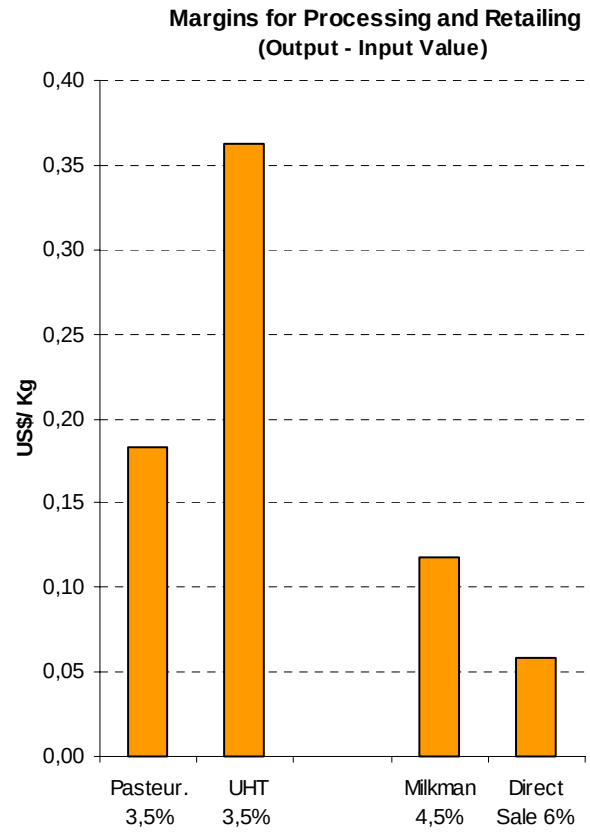
The farmers’ shares in the price paid by the consumer for the end products are twice as high in the informal sector than in the formal sector. Due to the much higher capability of the formal sector to add value to the milk, one may expect that farmers’ shares in the consumer prices may decrease even more in the formal than in the informal sector, when other processing steps are included in the analyses.

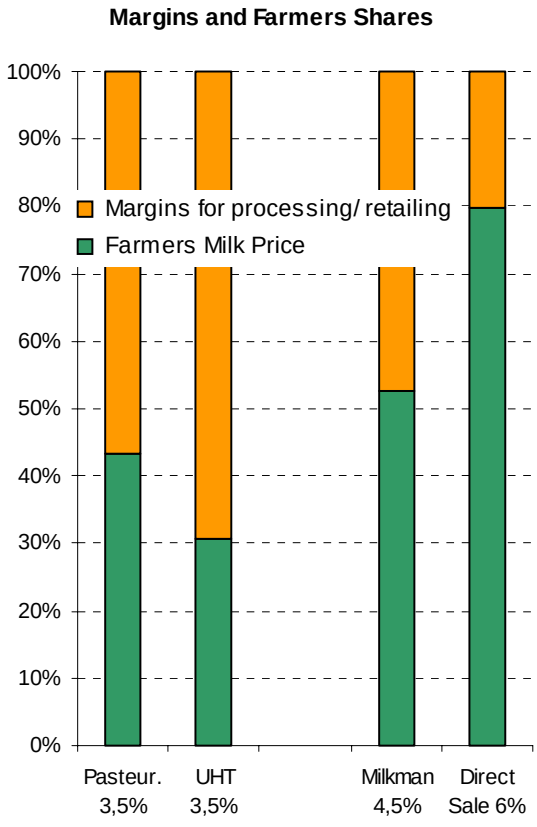
Explanations of variables; year and sources of data:

- **Input Costs:** Milk price paid to the farmer
- **Returns:** Consumer price for milk as specified and cream extracted (with 30% fat)
- **Farmers Milk Prices:** Local price of whole milk sold.
- **Farmers Milk Price for Direct Sales:** Potential milk price in this urban location.
- **Consumer Prices:** Price for the product as specified.
- **Margin:** Covers transport, processing and retailing costs.
- **Source of Data:** Personal Communications (Interviews on February-March 2003).


Input costs of the Dairy Chain
Basis 1 kg milk from the farmer 6%fat
US/ kg milk
0,6
0,5
0,4
0,3
0,2
0,1
0,0
Farmers Milk Prices
Pasteur. 3,5%
UHT 3,5%
Milkman 4,5%
Direct Sale 6%


Returns of the Dairy Chain
Basis 1 kg milk from the farmer 6%fat
US/ kg milk
0,6
0,5
0,4
0,3
0,2
0,1
0
Output 2: Cream sold
Output 1: Milk sold
Pasteur. 3,5%
UHT 3,5%
Milkman 4,5%
Direct Sale 6%


Margins for Processing and Retailing
(Output - Input Value)
US$/ Kg
0,40
0,35
0,30
0,25
0,20
0,15
0,10
0,05
0,00
Pasteur. 3,5%
UHT 3,5%
Milkman 4,5%
Direct Sale 6%


Margins and Farmers Shares
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Margins for processing/ retailing
Farmers Milk Price
Pasteur. 3,5%
UHT 3,5%
Milkman 4,5%
Direct Sale 6%

4 CONCLUSIONS

Household activities and income levels

The mix of household activities varies significantly between farm types. Only farms of type PK-1 receive the major part of their income from off-farm sources (around 75 percent). Annual household incomes vary between US$ 620 and 3,000. This variation includes the non-cash benefits (manure and milk for home consumption), which amount to between 11 and 19 percent of total household income. For farms of type PK-1 the non-cash benefits are about two and a half times higher than the net cash farm income.

All households' cover their living expenses from the income generated and make a surplus (from US$ 110 to 1,900). In the case of farms of type PK-1 the income per household member is US$ 89 per year, which leaves this family living in very poor conditions.

Competitiveness of dairy farming

The farms of type PK-3 and PK-10R that have land to grow crops and forage are able to produce milk at costs of US$ 11.50 and 8.25 per 100 kg. These farm types have the potential to not only compete with imports but also produce milk for exports.

The cost of production in the farm PK-1 amount to US$ 17.50 per 100 kg, about one and a half times the cost of farms of type PK-3. This is mostly explained by the low milk yield.

Without any **support interventions**, farms of type PK-1 will keep failing to make a profit and will not be able to operate in the longer run.

Dairy marketing chain in Punjab (preliminary estimates)

Despite the milk having a lower fat content, consumers are willing to pay higher prices for fresh milk from the formal sector, in which prices are about one and a half times those charged in the informal sector. This premium can be explained by the higher quality of the milk offered by the formal sector, which has been pasturized and packaged, extending milk shelf life by 3 to 4 weeks.

The formal sector in Lahore has an average milk-processing-and-retailing margin, which is half of that reached by European dairy processors. The margin is highest (US$ 0.36 per kg) for the UHT 3.5 percent fat milk. The lowest margin (US$ 0.06 per kg) is obtained by the farmer who directly sells milk with a 6 percent fat content to the consumer.

This preliminary analysis of the dairy marketing chain in Lahore shows that the farmers' shares in consumer prices are about twice as high in the informal than in the formal sector with about 98 percent of the milk in Pakistan flowing through these informal channels. There is a need for more reliable research on the dairy marketing chains to support policy making directed at both increasing dairy chain efficiency and small-scale dairy farmers' participation.

A1 METHODOLOGICAL BACKGROUND

In this chapter, we will present the methods and sources of information used to collect data about the Pakistan dairy sector and how the costs of production for the selected typical production systems are calculated.

This project has followed the framework used by the International Farm Comparison Network (IFCN). IFCN is a world-wide association of agricultural researchers, advisors and farmers. These participants select typical agricultural systems in key production regions in their individual countries. In 2002, the number of participating countries extended to 24 that represent 74 percent of the world milk production.

Within this scientific Network, FAL-Federal Agricultural Research Centre (Germany) through its Institute of Farm Economics and Rural Studies is acting as the co-ordination centre for scientific issues.

The central objectives of IFCN are:

1. To create and maintain a standardized infrastructure through which production data of the major agricultural products (milk, beef, wheat, sugar, etc.) and from major producing regions of the world can be effectively compared and discussed.

2. To analyze the impact of the structure of production, technology applied and country-specific policies on the economic performance of agri-businesses, their costs of production and global competitiveness.

In order to achieve these objectives, IFCN employs the following **methods and principles**:

Direct contact with the production protagonists. A team of advisors and farmers is put together to set up the typical production models and to revise the final results. This approach brings the results closest to reality.

The principle of 'Total Costs'. IFCN considers both direct costs and margins, and the indirect (fixed) costs (i.e. depreciation and interests of the infrastructure used) and the opportunity costs for owned assets and production factors (i.e. family labour, land, capital).

A single and homogeneous method is utilized to calculate the costs of production for all participating countries. The IFCN standard is not the only truth, but a) it is scientifically correct, b) it includes all the existing production costs, and c) it creates transparency and international comparability in the arena of costs of agricultural production. Each IFCN member and client can reorganize the costs at his convenience and present them in the particular format of his country while he maintains an internationally comparable set of results.

The concept of setting (regional) typical agricultural models. A team of country experts, advisors and producers is formed to identify and set up the typical regional production models for each agricultural product. Typical production models must represent the common production structures in the region or country.

In the case of dairy production, for example, a working team composed of advisors, consultants and producers is formed as a panel. The first working step is to define the typical milk production systems of the major dairy regions in country. This model may be a 4-cow farm, feeding mostly cut grasses to fully confined animals, combine milk production with some other agricultural activities such as wheat and rice production in 3 ha of irrigated owned land, and milking is done by hand twice a day.

The second working step is to collect all the needed information from these typical models. For this, IFCN has developed a standard questionnaire. It is crucial that these data collected should neither reflect an individual farm (too many particularities may hurt the ability to generalize the results) nor be an arithmetic average (an average does not show much about the technology and the economics involved). The typical model should rather represent real and common situations of the region and show clearly the predominant technology and infrastructure. Analysts will prefer such models.

The model TIPI-CAL (**T**echnology **I**mpact and **P**olicy **I**mpact **Cal**culations) is utilized for the simulations of these typical models and the calculations of their costs of production. TIPI-CAL can be easily shared with all IFCN members since it is a spreadsheet in MS-Excel. This model is a combination of production (physical data) and accounting (economic data). TIPI-CAL also consists of both a structure of costs of production and a simulation component (without optimization). The simulations can be done for a period of up to 10 years in order to evaluate the growth, investments, policies or market conditions. For each year, TIPI-CAL produces a 'Profit and Loss Account', a balance and cash flow statement.

Allocation of costs of production. When the typical milk production systems have several agricultural activities besides dairy, fixed costs and expenses (i.e. depreciation) are distributed to each activity according to their use. For example, the depreciation of the machinery, which is used, for the dairy and the crop enterprises is allocated according to the hours worked in each.

Data about farm and off-farm household economics. IFCN takes into account all activities of the typical production systems, plus all the off-farm incomes and expenses realized by the owner and his family. This more complete picture of the typical model is necessary to obtain reliable information about the current economic situation of the model (and the household) and about the future of the farm (simulations).

All the methods and principles above have been applied in this project. Full panels were not set up since these models have already been part of the IFCN activities for the year 2002. The IFCN fieldwork experience supports that the analysis of costs of production shows no significant difference between the participation of one advisor and a 'full panel'. Therefore, it was decided that an IFCN scientist first visit each and every model, talk with the owners to collect project-specific information, analyze the data and then have the results cross-checked by local experts and farmers.

The analysis of costs of production and the competitiveness of the typical models are found in part 3.5 and 3.6. The graphs follow the same structure as those in the '**IFCN Annual Dairy Report**'. The main objective of this report is to analyze the main typical milk production systems in the province of Punjab, Pakistan. This report shows the comparative world position of the Pakistani dairy industry and a comparison of the costs of production for the main milk production systems in Punjab.

For more information about IFCN, visit www.ifcnnetwork.org and www.ifcndairy.org

A2 IFCN METHOD: COSTS OF PRODUCTION CALCULATIONS

Cost calculation

The cost calculations are based on dairy enterprises that consist of the following elements: Milk production, raising of replacement heifers and forage production and / or feed purchased for dairy cows and replacements.

The analysis results in a comparison of returns and total costs per kilogram of milk. Total costs consist of expenses from the profit and loss account (cash costs, depreciation, etc.), and opportunity costs for farm-owned factors of production (family labour, own land, own capital). The estimation of these opportunity costs must be considered carefully because the potential income of farm owned factors of production in alternative uses is difficult to determine. In the short run, the use of own production factors on a family farm can provide flexibility in the case of low returns when the family can chose to forgo income. However, in the long run opportunity costs must be considered because the potential successors of the farmer will, in most cases, make a decision on the alternative use of own production factors, in particular their own labour input, before taking over the farm. To indicate the effects of opportunity costs we have them separated from the other costs in most of the figures.

For the estimations and calculations the following assumptions were made:

Labour costs

For hired labour, cash labour costs currently incurred was used. For unpaid family labour, the average wage rate per hour for a qualified full-time worker in the respective region was used.

Land costs

For rented land, rents currently paid by the farmers were used. Regional rent prices provided by the farmers were used for owned land. In those countries with limited rental markets (like New Zealand), the land market value was capitalized at 4 per cent annual interest to obtain a theoretical rent price.

Capital costs

Own capital is defined as assets, without land and quota, plus circulating capital. For borrowed funds, a real interest rate of 6 per cent was used in all countries; for owner's capital, the real interest rate was assumed to be 3 per cent.

Quota costs

Rent values were used for rented or leased quota. Purchased quota values were taken as being the annual depreciation of values from the profit and loss accounts.

Depreciation

Machinery and buildings were depreciated using a straight-line schedule on purchase prices with a residual value of zero.

Adjustments of fat content

All cost components and forage requirements are established to produce ECM (energy corrected milk with 4.0 percent fat and 3.3 percent protein).

Adjustment of VAT

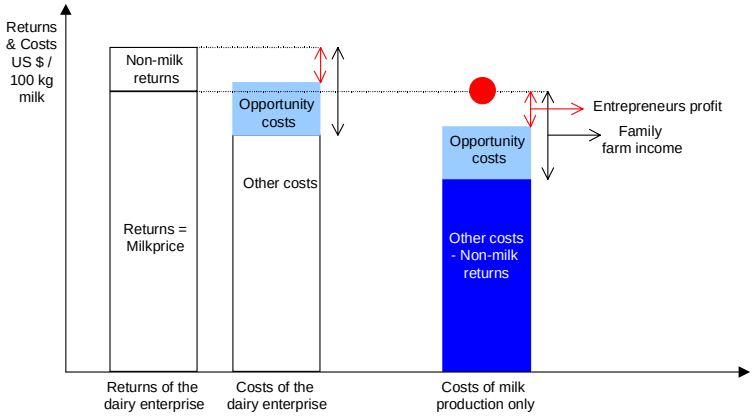
All cost components and returns are stated without value added tax (VAT).

Adjustment of milk into ECM

The milk output per farm is adjusted to 4 percent fat and 3.3 percent protein. Formula: ECM milk = ((total marketable milk production * 0.383*milk fat in percent) + (total marketable milk production * 0.242*milk protein in percent) + (total marketable milk production * 0.7832))/3.1138

Farm economic indicators (IFCN method)

Cost of milk production only



Method

The total costs of the dairy enterprise are related to the total returns of the dairy enterprise including milk and non-milk returns (cattle returns and direct payments). Therefore the non-milk returns have been subtracted from the total costs to show a cost bar that can be compared with the milk price. The figure beside explains the method.

Other costs: Costs from the P&L account minus non-milk returns (cattle returns and direct payments, excl. VAT).

Opportunity costs: Costs for using own production factors inside the enterprise (land * regional land rents, family working hours * wage for qualified workers, capital: Own capital * 3 percent).

Returns of the dairy enterprise:

Milk returns: Average milk prices adjusted to ECM milk (excl. VAT).

Cattle returns: Returns selling cull cows, male calves and surplus heifers + /- livestock inventory (excl. VAT).

Other Returns: Selling/home use of manure

Costs by costs items

Costs for means of production: All cash costs like fuel, fertilizer, concentrate, insurance, maintenance plus non-cash costs like depreciation for machinery and buildings (excl. VAT).

Labour costs: Costs for hired labour + opportunity costs for family labour.

Land costs: Land rents paid + calculated land rents for owned land.

Capital costs: Non-land assets * interest rate (equity * 3 percent, liabilities * 6 percent).

Quota costs: Payments for rented quota and depreciation for quota bought.

Cash and non-cash costs

Cash Costs: Cash costs for purchase feed, fertilizer, seeds, fuel, maintenance, land rents, interest on liabilities, wages paid, vet + medicine, water, insurance, accounting, etc (excl. VAT).

Depreciation: Depreciation of purchase prices for buildings, machinery and quotas (excl. VAT).

Opportunity costs: Costs for using own production factors (land owned, family labour input, equity).

Economic Results of the Dairy Enterprise

Farm income per farm: Returns minus costs from P&L account of the dairy enterprise.

Farm income per kg milk: Farm income per farm (dairy enterprise) / milk production

Profit margin: Share of farm income on the total returns: Farm income divided by the total returns.

Entrepreneurs profit: Returns minus costs from P&L account of the dairy enterprise – opportunity cost allocated to the dairy enterprise.

Net cash farm income: Cash receipts minus cash costs of the dairy enterprise or: Farm income + depreciation

Return to labour: Entrepreneurs profit plus labour costs (wages paid plus opportunity costs) divided by total labour input.

Average wages on the farm: This figure represents the gross salary + social fees (insurance, taxes, etc.) the employer has to cover. Calculation: Total labour costs (wages paid plus opportunity costs) divided by the total hours worked. To calculate this the number of hours worked by the employees and the family has been estimated by experts.

Labour input: The estimation of hours worked and the valuation of these hours is extremely difficult especially in family farms. In the IFCN network this method will be intensively discussed and improved during the next workshops.

Labour costs: Paid wages and opportunity costs for own labour of the dairy enterprise.

Land costs: Paid land rents and opportunity costs for own land (calculated rent) of the dairy enterprise.

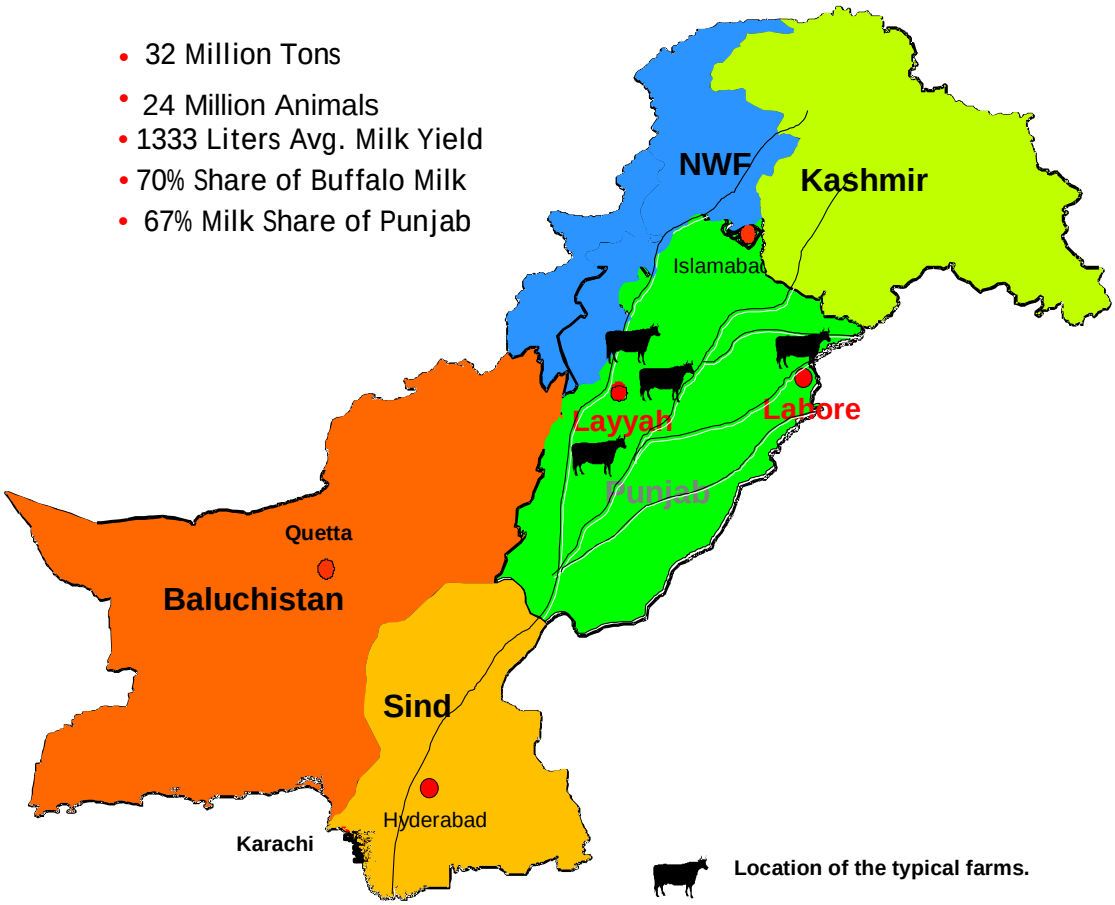
Stocking rate: Number of dairy animals (young stock included as Live Unit Equivalent)/ ha land allocated to the dairy enterprise.

Capital costs: Paid interests and opportunity costs for own capital (excluding land capital and quota capital). For equity 3 percent and for liabilities 6 percent interest rate is used in all countries. This reflects the method of "capital using costs" developed by Isermeyer 1989.

Capital input: Total Assets (land, buildings, machinery, cattle)/ number cows

A4 MAP OF PAKISTAN AND LOCATION OF THE TYPICAL FARMS

Pakistan



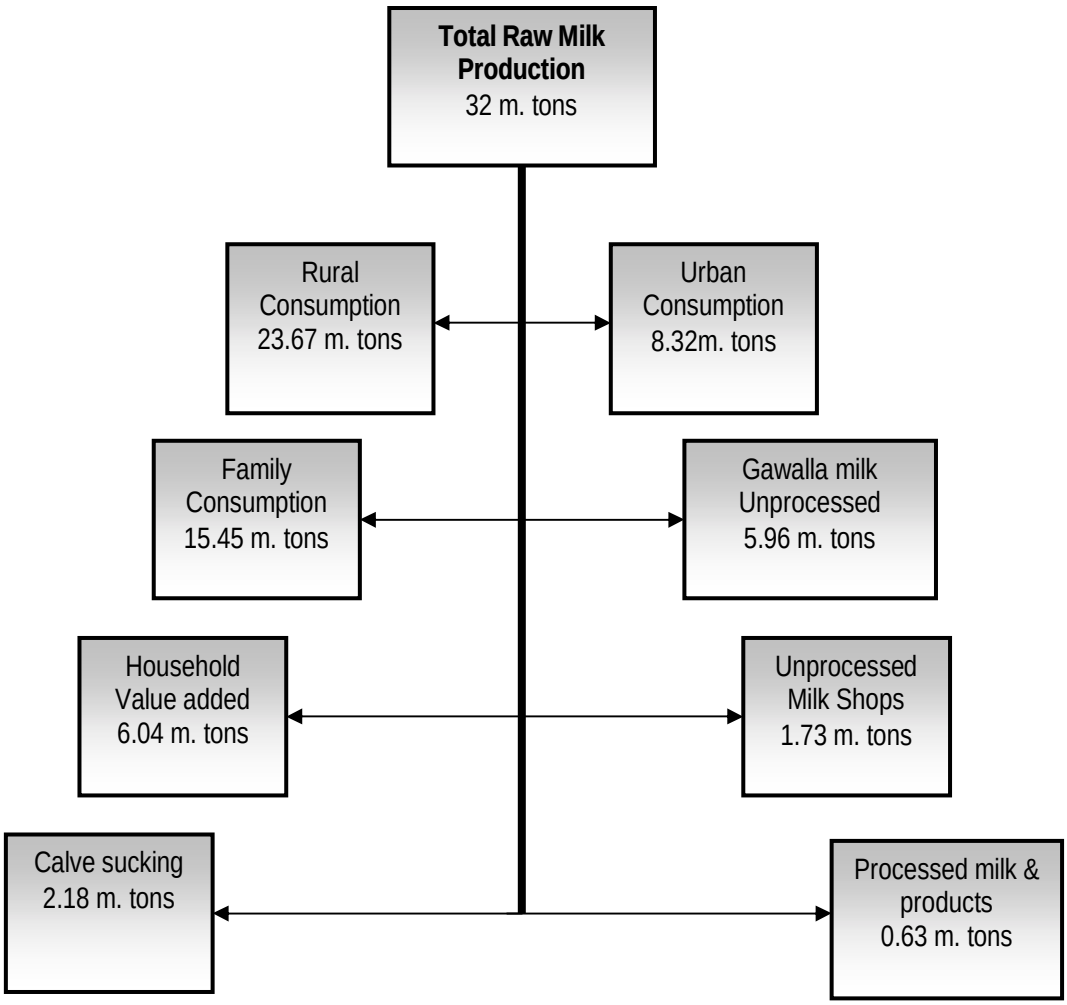
Source: Authors Own Illustration

A5 MAJOR DAIRY PRODUCTS IN PAKISTAN

Type of Milk	Market Share in Volume	Fat %	Milk Retail Price US$/Litre
Open Gawalla (milkman) Milk	90%	3.5 - 5	0.21
Direct to Home	0.02%	6	0.31
Open milk sold at Milk shops	0.98%	3.5 - 5	0.28
Open Pasturized Milk	3.76%	3.5	0.28
Pasturized Pouch	0.24%	3.5	0.34
UHT Polypack	0.02%	3.5	0.38
UHT Tetra Pack	4.98%	3.5	0.50

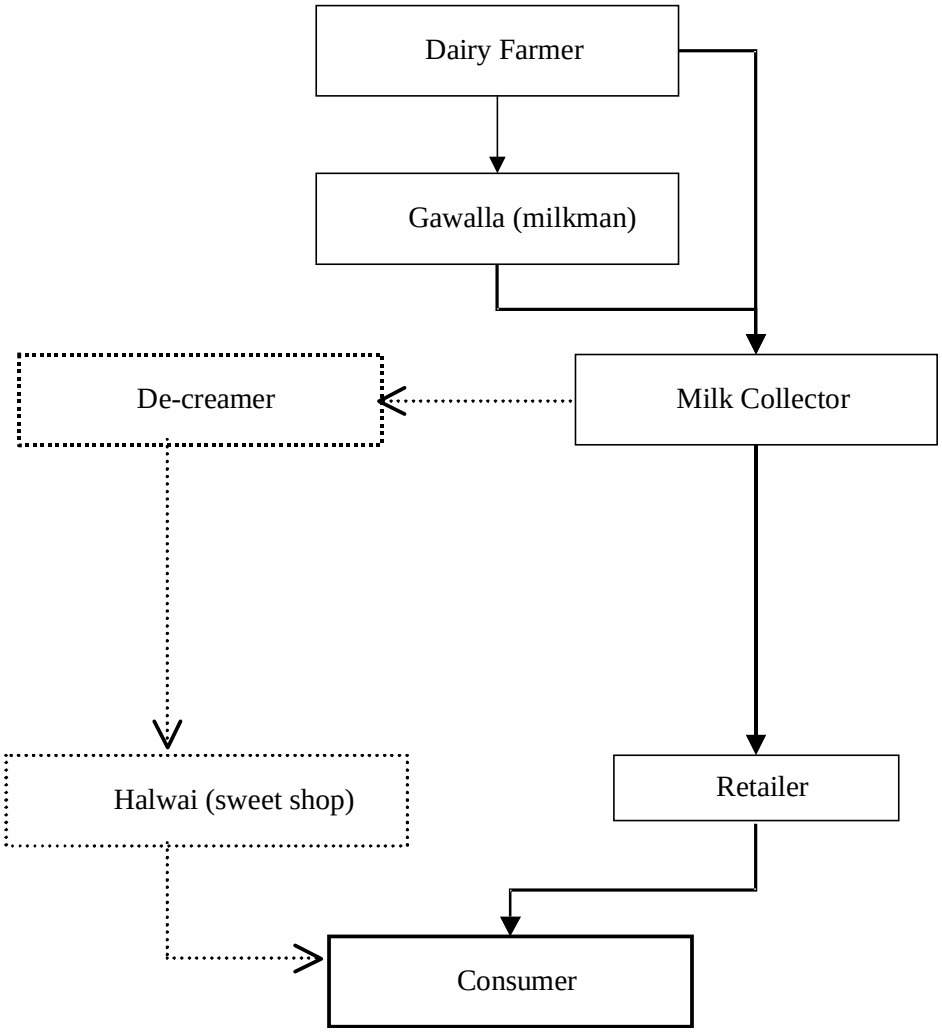
Source: Authors milk market survey November 2002.

A6 MILK DISTRIBUTION BY QUANTITY



Sources: a. Milk production from FAO Statistics, 2002. b. Milk Distribution based on SMEDA Report 2000.

A7 MILK SUPPLY CHAIN IN PUNJAB



Source: SMEDA Report 2000.

A8 CALCULATIONS OF THE DAIRY MARGINS IN LAHORE

		Formal Milk Channels		Informal Milk Channels	
		Pasteur. 3.5%	UHT 3.5%	Milkman 4.5%	Direct Sale 6%
Variables	**Units**				
Dairy Processing activities based on 1 kg milk bought from the farmer					
INPUTS					
Input: Milk from the farmer					
Quantity	Kg	1	1	1	1
Fat Content	% estimation	6%	6%	6%	6%
Protein Content	% estimation	3.5%	3.5%	3.5%	3.5%
Purchase Price	US$/ Kg	0.14	0.16	0.13	0.23
FARMERS MILK PRICES	**US$**	**0.14**	**0.16**	**0.13**	**0.23**
OUTPUTS					
Output 1: Milk sold	Description	**Unpacked**	**Tetrapack**	**Creamless**	**Whole**
Quantity	Kg	0.91	0.91	0.95	1.0
Fat Content	%	3.5%	3.5%	4.5%	6%
Protein Content	% estimation	3.2%	3.2%	3.2%	3.5%
Consumer Price	US$/ Kg	0.26	0.48	0.21	0.29
Output 2: Cream sold					
Quantity cream	Kg	0.09	0.09	0.05	0,000
Fat content of cream	%	30%	30%	30%	0
Quantity of fat	Kg	0.03	0.03	0.03	0
Consumer price for cream	US$/ Kg	0.96	0.96	0.96	0
TOTAL CONSUMER PRICES	**US$**	**0.32**	**0.52**	**0.25**	**0.29**
MARGINS					
Sum of all Returns	US$	0.32	0.52	0.25	0.29
-Farmers Milk Price	US$	0.14	0.16	0.13	0.23
FINAL MARGINS	**US$**	**0.18**	**0.36**	**0.12**	**0.06**

Notes: Exchange rate: 62.45 Rs. per US$

1- Milk handlers in Lahore use multiple methods and accurate information on them is seldom shared. For this preliminary calculations, we found necessary to collect the most important variables and use a standard and simplified method to compare the main dairy channels.

2- The assumptions of the method chosen are: 1- each channel buys one Kg 6 % fat milk from the farmer, 2- each channel processes this Kg milk into its most popular milk plus cream when applicable, 3- no other input is added (i.e. water, fat, milk powder, etc.), and 4- this milk and cream are valued at the (final) consumer market prices in Lahore.

3- The channel called Pasteur 3.5% refers to pasteurized milk, which is sold unpacked and at milk shops.

Source: Prices and processing channels were gathered in Lahore through personal communications; fat and protein contents for the Informal sector are based on assumptions from the Authors.

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Annexes

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