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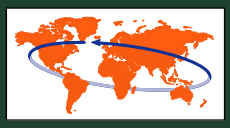

International Farm
Comparison
Network (IFCN)

The Economics of Milk Production in Cajamarca, Peru, with Particular Emphasis on Small-Scale Producers

Otto Garcia and Carlos A. Gomez

PPLPI Working Paper No. 34

A Living from Livestock

TABLE OF CONTENTS

Annexes

PREFACE

This is the 34th of a series of Working Papers prepared for the Pro-Poor Livestock Policy Initiative (PPLPI). The purpose of these papers is to explore issues related to livestock development in the context of poverty alleviation.

Livestock is vital to the economies of many developing countries. For low income producers, livestock can serve as a vital source of food, store of wealth, provide draught power and organic fertiliser for crop production and a means of transport. Consumption of livestock products in developing countries is growing rapidly.

The study applies a method of economic analysis developed by the International Farm Comparison Network (IFCN) which is based on the concept of 'typical farms'. Three farm types were selected to represent typical farms in the region of Cajamarca, Peru. Each farm is described in detail with assets, production costs, profits and other economic information presented both graphically and in the text. In addition, the study presents a description and margins analysis of the dairy and feedstuffs chains in Cajamarca.

We hope this paper will provide useful information to its readers and any feedback is welcome by the authors, PPLPI and the Livestock Information, Sector Analysis and Policy Branch (AGAL) of the Food and Agriculture Organization (FAO).

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Keywords

Milk production, Andes, Peru, Poverty Reduction, Dairy, Farm Economics, Policy.

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1. EXECUTIVE SUMMARY

Introduction

The main purpose of this study was to gain insight into the household and farm economics of small-scale dairy farmers in the highlands of Cajamarca, northern Peru, and to obtain estimates of their costs per unit of output in milk production so as to gauge their potential for improvement of their dairy enterprise, particularly through policy action, and to assess their vulnerability to international competition in a more closely interconnected world market. In order to ascertain possible developments in the dairy sector and to broadly identify areas of intervention that favour small-scale dairy producers, the study examines the potential to improve milk production of the predominant farm types. Exploratory analyses on the distribution channels of both feed inputs and milk outputs in the region were carried out. Lastly, a case study approach is used, whose main aim is to obtain qualitative insights rather than to permit quantitative extrapolation.

Methodology

The methodology applied for the economic analysis was developed by the International Farm Comparison Network (IFCN) and builds on the concept of typical farms. Farm types are determined by regional dairy experts taking into consideration (a) agro-ecology and location of the farm, (b) farm size in terms of herd size and (c) the production systems that make the most important contributions to milk production in the region. The following three farm types were found to represent over 75, 90, and 95 percent of the regions' milk production, cow numbers and farm numbers respectively. The first type of farms (5 cows) represents the typical dairy farm in the *Jalca-Ladera* area (>2,800 masl*); the second category (6 cows) was chosen to represent the majority of dairy farms in the high intra-mountainous valleys (2600 to 2800 masl*), and finally, a third farm type (13 cows) represents the typical production system found in the Cajamarca valley (2500 to 2600 masl*). Management levels on the farms selected for the study are average to slightly above average compared to other farms of the same type. 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 farms. Furthermore, method testing exercises were conducted regarding the feed chain analysis The methodology used is further explained in the corresponding sections and/ or the Annexes at the end of the paper.

Results

Milk production in Peru

Milk production in Peru increased at a rapid rate of 4.5 percent annually between 1996 and 2003. This production growth has been driven by: better access of the main dairy processors to the remote highland producers, a growing number of dairy farms (2.2 percent per year), and better milk yields (2.5 percent increase per year). However, the period 2002-2003 shows a milk production growth reduced to below 3 percent.

Even with the steady growth of over 4 percent per year and stable investments in the three main milk sheds, Peru imports about 25 percent of its milk consumption. In

* masl: metres above sea level.

addition, the government spends an approximate US$ 200 million a year on milk and milk products for its governmental food assistance programs.

Analysis of 'typical farms' in the region of Cajamarca, Peru

Based on the IFCN methodology, three farm types were identified as 'typical' and were subjected to detailed analyses. A small dairy farm, PE-5 (located in the Sierra, holding 5 crossbred and Holstein Friesian cows, with 5.55 ha of land mostly for natural grass and some cash crops for own consumption), PE-6 (located in a typical high Cajamarcan valley, 6 Holstein Friesian and Brown Swiss cows, and 7.60 ha land with natural grass, cultivated pastures and some cash crops for own consumption), and a more 'progressive' farm, PE-13, which represents the more commercially-managed dairy systems in the area (located in the *Campina*, near the city of Cajamarca; holding 13 Holstein Friesian cows, with 7.30 ha land for cultivated pastures and no cash crops). Furthermore, these farm types selections cover the predominant socio- and agro-climatic conditions governing milk production in the Andean regions.

Dairy production systems

In the last two decades, dairy has gained relevance as a key component of the typical farming systems. This fast growth in milk production (>4 percent per year) can be attributed to the increasing milk demand of the dairy processing sector. The growing and secure market has provided a major incentive for private investors around Lima as well as small and remotely located farmers in the highlands to produce more milk. Dairy farms around the capital are relatively large, cows are stall fed, use much concentrates (resulting in high costs of production) and obtain high milk prices while in Cajamarca, the predominant farming system combines crops and animal production to best utilize the available resources and to assure a higher income throughout the year.

Dairy farming in Cajamarca varies strongly across farming systems, depending on the socio- and agro-climatic conditions, dominating factors being access to water and altitude. Farms at the high end of the Sierra usually have about 2 to 5 crossbred dairy cows grazing natural pastures. With no irrigation, this system can carry less than one animal per hectare of pasture and faces severe fodder scarcity during the dry season (May to October). During the rainy months, several cash crops are grown on lower sites mostly for home consumption.

A second 'typical' dairy farming system is found in high intra-mountainous valleys, which can be irrigated by using small rivers. Here, farms have 4 to 6 Holstein Friesian cows, which are fed some concentrates. Market access is relatively good and farmers cultivate pastures all year long. Fodder conservation for the dry season is not practiced. Some cash crops are grown for home consumption.

In the valley of Cajamarca, milk production relies on more concentrates, better genetics and often mechanized milking. Although, farmers here count with higher milk prices and milk yields per animal, their production costs are also high in comparison with the other system described here. Therefore, it appears that milk production in Cajamarca is 'moving up the Sierra'.

Household comparison

This study shows that typical dairy households in Cajamarca have daily per capita incomes of US$1.5 and 2.0 for PE-5 and PE-6, both in the rural *sierra*. For the urban *sierra* location, PE-13 achieves an income of US$ 9.5 per capita per day, which is more than double and triple the urban *sierra* and national Peruvian average daily income found by the World Bank respectively.

From another perspective, the total annual household incomes range between US$ 2,200 and 10,500. The net cash farm income accounts for 95 and 55 percent of the household incomes for the small and large farms respectively.

Non-cash benefits are most relevant for the smallest farm. However, even for PE-5, non-cash benefits (milk and manure) reach a low 5 percent of the household income due to the fact that typical dairy farm families, in the Andes, both consume little milk and the manure is spread on the fields by the grazing animals themselves. By contrast, in countries such as India, a small dairy farmer would add value to both milk and cow-dung used by the family. This in turn increases the relevance of non-cash benefits from the dairy.

All three households merely cover their family living expenses and only the largest, peri-urban farm can save about US$600 per year.

Whole farm comparison

The farm returns range from US$ 3,200 to 20,300 per year. Over 80 percent of the farm returns for the two smaller farms come from the dairy and the rest from cash crops. Some small ruminants are also raised for home consumption. The larger farm is fully specialised in dairy and forage production.

All farms have excellent profit margins, which are in the order of 70 and 30 percent for the smallest and largest farm.

Comparison of the dairy enterprise - Costs of milk production

The total cost of milk production varies from US$ 28 to 23 per 100 kg ECM. The farm PE-6's low production costs (US$ 23) are mainly due to lower costs of family labour. However, when only cash costs are considered, PE-5 has no costs (due to using family labour and natural grasses only) while the other two farms have cash expenses of US$ 5 and 15 per 100 kg ECM (for purchased concentrates and inputs for cultivated pastures).

The returns between the farms differ between US$ 29 and 35 per 100 kg milk. Differences in milk returns can be explained by farm location in relation to the city of Cajamarca, milk quality (bonuses for fat content, acidity and tuberculosis and brucellosis status), and the farmer's price-negotiating power.

Due to milk yield differences, the returns of the small farm are 60 and 40 percent from milk and cattle sales; while for the larger farm 75 percent of the returns stem from milk sales.

The dairy returns from working on the dairy enterprises of the two smaller farms are about 65 percent of the local wages. However, the return to labour on the larger farm surpasses the local agricultural wages by 8 percent (high labour productivity).

Dairy chain in Cajamarca

About 75 percent of the milk produced in the province of Cajamarca reaches the formal processing sector, namely Nestle or Gloria S.A. However, farms producing less than the minimum daily quantity required by these companies (15 kg milk) or those not located on the formal milk collection route usually process their milk or sell it to small dairy processors, mainly cheese-makers. Cheese-making catches about 24 percent of the province's milk output, which is converted into *quesillo* (a fresh curd cheese, which forms the basis for the popular *queso cremoso*, a creamy Cajamarcan cheese). The remaining one percent left is estimated to be consumed by the farm households themselves.

Producer milk prices are US$ 0.21 and 0.24 per kg in the formal and informal sectors respectively. However, the consumer price is 2 times greater for the formal sector's evaporated milk, which has a long lasting and well established acceptance.

The margins attained from processing and retailing are US$0.40 and 0.07 per kg of evaporated milk and fresh (cheese) curd in the formal and informal channels respectively.

Lastly, farmers' shares in the total consumer prices are 35 and 78 percent in the formal and informal channels. In similar studies for Asian countries, farmers capture lower shares (below 30 percent) than Cajamarcan farmers. Regarding the informal sector, Cajamarca has the peculiarity that farmers, who are not linked to the main milk collectors, convert their milk into cheese curd. This simple processing step not only lengthens the shelf-life of the milk, but also adds value to it. Because of this value-adding the farmers' share of the consumer price is extremely high, particularly compared to dairy chains in South Asia. It is estimated that cheese-makers could increase their profitability and maintain the higher milk price paid to farmers if they were better trained.

Feed chain in Cajamarca

Dairy farmers in Cajamarca feed small amounts of complete feed mixes as supplements to both cultivated and natural pastures. Others purchase and feed wheat middling (mostly from imported wheat), cottonseed meal (domestically produced), and mineral and vitamin premixes (mostly from imported ingredients) separately and on a per cow basis. This study shows that about 29 percent of the feed price paid by the dairy farmers is to cover costs of transportation, processing, and retailing from the primary distributor in Lima to the farms in Polloc, Cajamarca. Poor conditions of the road system linking the highlands to the coast and its vulnerability to bad weather makes the transportation of inputs into and milk out from the highlands difficult for the dairy industry. Clearly, the Cajamarcan dairy industry would benefit greatly from a more competitive road infrastructure system linking it to the growing markets in the coastal regions.

Conclusions

Several key conclusions emerge from this study:

1. Increasing milk production in Cajamarca is profitable for the farm types studied in the sierra, and appears to be a good strategy for the country as a whole since international milk powder prices are most likely to increase, significantly raising Peru's import bill.
2. The most limiting factor for farmers shifting to milk production in the high sierra, where PE-5 is located, is access to irrigation water. Rainfall is seasonally distributed with a pronounced dry season from May to October. Despite this fact, PE-5 practices no forage conservation at all, which may largely explain its low milk yield of about 1,600 kg per year per animal, or 55 percent of the yield reached by PE-6. The practice of cultivating improved pasture and/or better utilization of natural ones is required for PE-5 to cost-effectively enhance its income and create a base for other dairy improvements, such as better breed and herd management.
3. PE-5 shows very poor herd performance indicators such as high mortality rates, high ages at first calving and long calving intervals. Improvements in herd management would positively impact the profitability of this farm type. This can be done by partnering with the private sector and NGOs already operating in the area. Such services could then expand to adjacent regions, not yet served.

4. Dairying is a highly risky activity in the sierra. The study shows that households with off-farm income make higher investments in milk production, which in turn leads to higher farm incomes. Off-farm incomes seem to have two key impacts on the dairy enterprises: (1) increasing the household's capacity to make investments in income generating activities, and (2) decreasing the total household income risk level, so it can invest in riskier activities.
5. Significant parts of both the consumer prices for dairy products and the farmer prices for feedstuffs go towards covering processing, transportation, and retailing costs. Investment in roads, markets, energy and telecommunications are expected to decrease these costs. Dairy development in the region will demand more efficient chains that connect the high sierra farmers with the coastal markets for both farm inputs and outputs.
6. Small dairy farmers in Cajamarca, disconnected from the main dairy processors, convert their milk into curd and sell it to cheese-makers. Cheese curd production allows the farmer to add value to the milk and to capture a relatively high share of the final consumer price. This decreases the profitability of the typical small cheese-making operation, which seems to be disappearing rapidly. There is a strong need to evaluate the role and economics of the small local cheese-makers and their potential role as a developmental actor to serve small dairy farmers excluded from the formal dairy processing stream and the local consumers.
7. Milk production in the country has been increasing at about 4.5 percent annually for the past decade. However, milk production seems to increase in the confined-intensive systems of the coasts at a much faster pace than in the Sierra. Therefore, there is a need for a comparative study to assess if the sierra-coast gap in milk production is widening or not.
8. In general the productivity of livestock in the sierra is low. The major cause is said to be poor animal nutrition, particularly during the dry season. To improve nutrition forage production must improve. Livestock development entities have promoted the use of cultivated pastures, but their programs have been successful only in areas where irrigation is possible and where no direct competition with cash crops exists. Regarding native rangelands, the potential impacts of their improvement may be far reaching due to two main reasons: (a) improving native rangelands has the potential to increase daily milk yields from the current 3 kg up to 6 and even 8 kg per animal per day; and (b) most of this yield increase could be captured by small-scale dairy farmers, who rely heavily on rangeland pastures as the most important nutritional component for their (dairy) animals.
9. Peru faces an unfavourable milk-feed price ratio, which is due to high concentrate prices. This study shows that feed distribution channels in Cajamarca have high transportation costs and many intermediaries, both of which significantly increase the prices of feedstuffs at the farm gate. There are local initiatives addressing this feed price issue, whose (pro-poor) impacts can be enhanced through partnerships.

2. OVERVIEW – MILK PRODUCTION IN PERU

Milk production

Milk production in Peru has increased by about 4.5 percent annually for the past decade. Total milk production has gone from 0.9 to 1.2 million tons from 1996 to 2003, which is a 36 percent increase. This growth has been driven mostly by: an increasing demand for dairy products in urban areas and improved access to highland dairy farmers by the main dairy processors. By better connecting demand and supply, Peru has experienced both increases in milk yield per cow and in the number of dairy animals at the rates of 2.5 and 2.2 percent per year from 1996 to 2002.

Dairy farm structures

Although the number of dairy farms has increased at 2.2 percent per year from 1996 to 2003, average herd size has remained stable at 6.1 cows. The growth in number of dairy farms is taking place both (1) in the coast of the Lima and Arequipa Departments due to excellent market access, and (2) in the Peruvian highlands, where production costs are lower and, more importantly, because of increased milk collection by processors.

Feed prices

Feed prices in Peru have increased by 26 percent from 1996 to 2003, while the milk price has gone up by 48 percent in the same period. This has improved the milk-feed-price ratio by 17 percent, which has a positive impact on farm profitability. It is estimated that feed prices can decrease significantly if the highland dairy sector could count on better conditions of the road systems that link the highlands with the coast.

Milk consumption and imports

Per capita milk consumption has been constant (41-43 kg/year) over the last 10 years in spite of the increase in production. Consumption includes a low share of processed dairy products such as butter (0.06 kg/year), cheese (0.24 kg/year) and yoghurt (0.48 kg/year). The total consumption includes 40 percent as fresh (not processed) milk, 53 percent processed milk (35 percent thereof are based on imported products like milk powder) and 6 percent imported dairy products. Recent efforts have been made by dairy processors to increase milk consumption through massive advertising campaigns.

Explanations of variables; year and sources of data:

- Milk production in the country: FAO. Cows: FAO. Yield per cow: Production/ cows (calculated).
- Farm structure: www.cnd.gob.pe ; Number of dairy farms: www.cnd.gob.pe
- Feed price: Farm survey data.
- Beef price: Farm survey data (cull cow price). Land price: Farm survey data.
- Milk price: IFCN Dairy Report 2005
- World feed price: FAPRI briefing book 2005.
- PEN: Peruvian Nuevo Sol (the national currency)
- Remarks: No. of cows per size class is estimated based on average farm size per size class: 5, 50, 150 cows per farm. The missing barley price in 2003 was estimated to be equal to the 2002 information.

Peru: Milk production 2003

Status 2003

- Main dairy regions: Cajamarca, Lima, Arequipa
- No. of dairy farms: 102,000 farms
- Average farm size: 6.1 cows, 12 t of milk
- Main size classes: < 20 cows = 80 % of the milk
- Milk / feed price ratio: 0.8; very high feed price

Key developments 1996 - 2003

- Number of farms: 14,000 farms; 2.2 % per year
- Farm number & structure based on estimates
- Milk / feed price ratio: Stable on a low upward trend
- Milk price: Increase in real and nominal terms

Milk density in the country 2003

Milk prod. in tons/ km² total land National average: 0,95

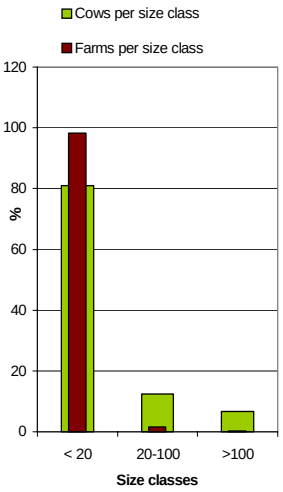
Source: Sistema Nacional de Estadística, Consejo Nacional de Descentralizatión

Key variables

		1996	1997	1998	1999	2000	2001	2002	2003	Annual growth rates (%) Average	2002-2003
Milk production											
Production	mill t	0,9	0,9	1,0	1,0	1,1	1,1	1,2	1,2	4,5%	2,7%
Cows	in 1000	553	526	520	518	513	538	628	635	2,2%	1,1%
Yield	t/cow/year	1,6	1,8	1,9	2,0	2,1	2,1	1,9	1,9	2,5%	1,5%
Farm structure											
No. of dairy farms	in 1,000 s	91	87	86	85	83	89	104	105	2,2%	1,1%
Milk per farm	t milk/farm	10	11	12	12	13	13	12	12	2,6%	1,5%
Average farm size	cows/farm	6,1	6,1	6,1	6,1	6,2	6,1	6,1	6,1	0,0%	0,0%
Prices in national currency											
Beef price	PEN / kg live weight	2,50	2,50	2,50	2,50	2,50	2,50	2,50	2,50	0,0%	0,0%
Land price	PEN / ha	24.950	25.617	26.223	27.123	27.693	27.963	28.230	28.630	2,0%	1,4%
Quota price	PEN / kg	no quota									

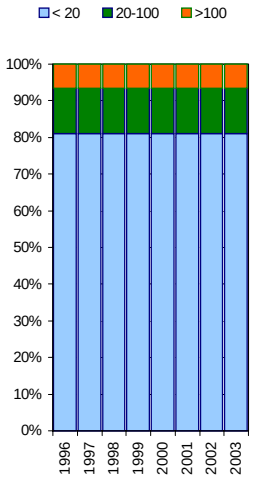
Farm structure 2003

% of dairy farms in size classes
% of cows in size classes



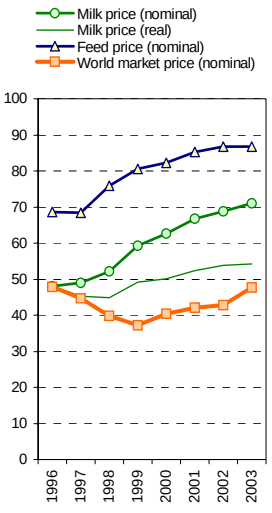
Farm Structure

% of cows in size classes

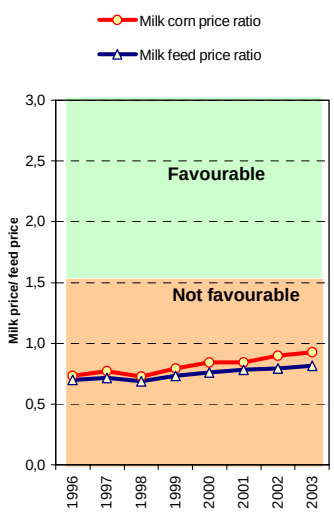


Milk and feed price

PEN / 100 kg



Milk-feed price ratio



3. IFCN ANALYSIS OF DAIRY FARMS IN CAJAMARCA

3.1 Description of the 'typical' farms in Cajamarca

The department of Cajamarca consists of 13 provinces, divided into 127 districts. Altitudes vary between 175 to 4,496 metres above sea level. This study focused on milk production in the province of Cajamarca as it represents the most predominant agro-climatic conditions of the department in particular and the Andean region in general.

Using the IFCN methodology, three typical milk production systems are identified in the Cajamarca region. One farm from each type has been analysed here. Each farm is briefly described while more details can be found in the table on the next page.

5-Cow farm (PE-5)

Located in Quinuamayo, Cajamarca, it is situated over 3,000 masl and at several hours drive from the city of Cajamarca. A family of four uses the method of tethering to graze their cows in natural pastures. No concentrates are fed. Three ewes are kept for home consumption and cash needs / emergencies. On the land, the family grows potatoes and beans mostly for home consumption and very little is sold. Off-farm employment is rare and when available is in distant construction projects or mining. Although at 5 km down the road there is a Nestle milk collection centre, this type of farmers sell to local cheese-makers, who offer higher milk prices and daily on-farm milk collection.

6-Cow farm (PE-6)

Located in Polloc, which represents one of the many typical altiplanos of Cajamarca (high valleys, about 2,800 masl). The particular agro-climatic conditions are said to be both the most promising and fastest growing milksheds in the region. Although farmers here seem very similar to PE-5 types (with subsistence cash crops and small ruminants), they are much more commercial about their dairy enterprises. They feed concentrates and some grow Alfalfa and Oats for their dairy animals. In some cases their cultivated forages exhibit yields and quality similar to larger farmers in more progressive areas. Farmers sell their milk to the major buyer, Nestle (cheese-makers are less numerous here), which picks up the milk daily, from the farm gate. The milk price is lower than PE-5's due to the poor transportation link with the city of Cajamarca (Nestle automatically deducts a transportation fee/kg milk). For off-farm income, the family provides transportation services with their pick-up truck.

13-Cow farm (PE-13)

Located in the Campina at about 2 km from the centre of Cajamarca city (at 2,600 masl). The farm utilizes hired labour, milking machines, concentrates, and grows forage oats and ryegrass associated with trifolium. All its land is irrigated. The received milk price is high due to both excellent market access and sale of most of the milk through the Vaso de Leche program (School Milk Program). At times, the farmer processes and sells own cheese to restaurants in the city. Urban growth and preference for larger residential areas with large green areas are presenting enormous challenges to this farm type. Likewise, this farm faces high costs of production compared to other dairy sub-regions. For off-farm income, one family member has a full time job in the city and the farm relies on hired labour.

Farm	Units	PE-5	PE-6	PE-13
Whole Farm				
Land Owned	Ha	4,05	7,60	7,30
Land Rented	Ha	1,50	No land	No land
Family labour	Hr/ yr	4920	5088	2304
Hired labour	Hr/ yr	1680	1404	5661
Full time employees	Persons	0	0	3
Dairy Enterprise				
Adult cows	No.	5	6	13
Breed	Description	3 Crossbreds * and 2 Holstein Friesian	4 Holstein Friesian & 2 Brown Swiss	Holstein Friesian
Liveweight	Kg	450	500	550
Milk yield	Kg ECM/cow	1739	3134	4586
Fat and protein content	%	4	3,8	3,5
% marketable milk sold	%	93	97	98
Land use Dairy enterprise				
Land use for dairy	Ha	5,0	7,0	7,3
Milk produced per ha	Kg ECM/ ha	1739	2474	8168
Stocking rate **	Cows / ha	1,0	0,9	1,8
Labour used for the Dairy				
Total labour input	Hr/ yr	3936	3562	7965
Share of family labour	%	100	100	29
Hours per milking cow	Hr/ cow/ yr	787	594	613
Buildings used for the Dairy				
Housing type	Description	Housing built with local materials (adobe and carrizo)	Housing built with local materials (adobe and carrizo)	Housing built with bricks, cements and local materials
Building Built	Year	1990	1985	1995
Milking				
Milking system	Description	Manual milking	Manual milking	Milking machine portable (3 Units)
Calves/ Animal/ Year	Head	0.5	0.66	1
Length of lactation	Days	300	300	250
Collection Centre	Km (far)	5	On-farm pick up ***	On-farm pick up***
Herd management				
Dry period	Months	5	4	2
Breeding	Method	Natural	Artificial	Artificial
Feeding times	Times/ day	0	1	2
Death rate	% cows	5	5	3
Cow Culling rate	% / year	10	17	16
Feeding systems				
Roughage feed source	Description	Rye grass + Trifolium / Natural pasture	Rye grass + Trifolium / Natural pasture	Rye grass + Trifolium for both cut&carry and seasonal grazing
Concentrates fed	Description	None	Commercial feed (concentrate)	Commercial feed (concentrate)
Concentrate use in total	Tons/ cow	0	0,60	1,12
Concentrate input	g / kg ECM	0	191	244
Calf rearing				
Death rate of calves	% calves	10	5	5
Weaning period	Months	8	6	2

Notes:

* Brown Swiss with Criollo

** Stocking rate considers mature cows only (no youngstocks).

*** milk processor picks up the milk daily right at the farm-gate.

3.2 Farm comparison: Household approach

Size of the household - Labour utilisation

Family sizes vary from 3 members near the urban area (PE-13) to 5 in the highlands. While the small farm family (PE-5) occupies all its labour on its own farm, the other two families have various off-farm activities: transportation services (PE-6) and one (private) job (PE-13), which typically uses up to 50 percent of the household labour of farmers in the low valley.

Household income levels

The household income shown here includes the net cash farm income, the off-farm salary and the value of the milk used in the farm and/or household. The incomes range between US$ 2,200 and 10,500.

For PE-13 the off-farm income constitutes 40 percent of the total household income. These off-farm employment opportunities for family members enable many dairy farmers near Cajamarca to keep farming.

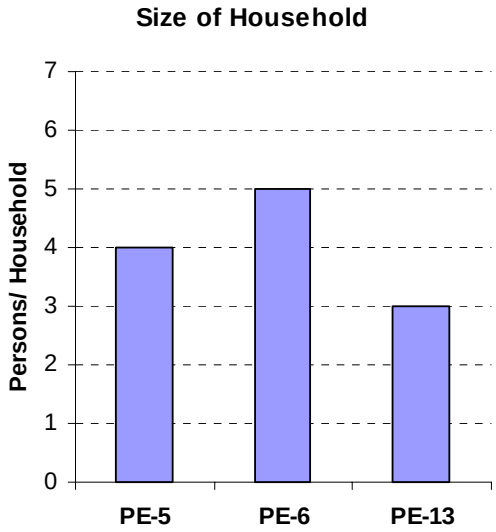
Non-cash benefits are minimal for all farms since little milk is consumed on the farm.

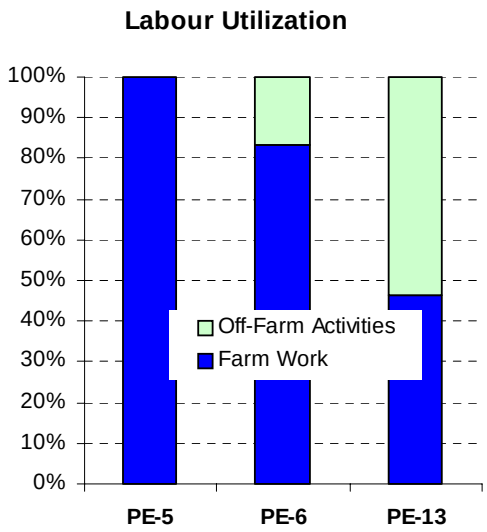
Household living expenses and equity growth

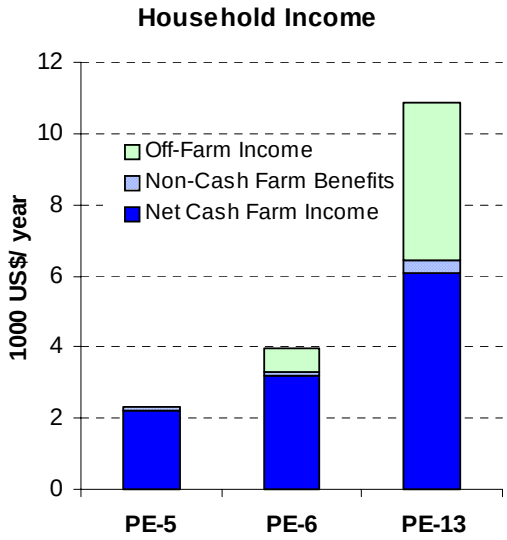
Although the data for living expenses proved difficult to collect, under the assumed framework, all farms are hardly able to cover their family living expenses. After living expenses are subtracted from the total household incomes, all household surplus ranges from US$ –200 to 600 per year. This means that under the prevailing technological and market conditions, these farmers can hardly cover their current living expenses (which are US$ 550 and 800 per capita and year for the two smaller farms). And even the larger farm is left with practically no saving capacity for investing in either livelihood or business improvements.

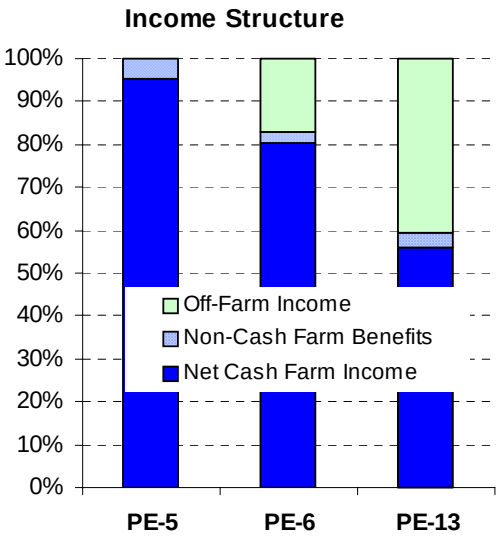
Explanations of variables; year and sources of data:

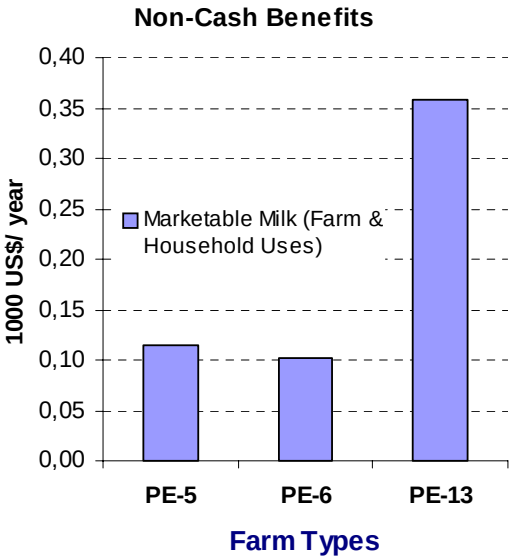
- Size of the household: People living together in one house as a family
- Labour utilisation: Total family labour used to generate income
- Household income: Includes cash and non-cash incomes from farm and off-farm activities
- Off-farm income: Includes all salaries for all family members
- Non-Cash Benefits: Value of cow manure used as fuel and fertiliser, draught power & milk used by family
- Household living expenses: Minimum annual cash expenses for the family to maintain the current living conditions.
- Sources of Data: IFCN database, expert estimations, and statistics, year 2004.

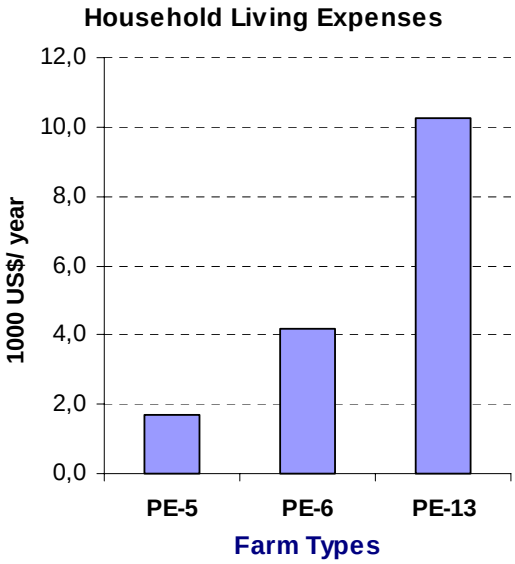

Size of Household
Persons/ Household
0
1
2
3
4
5
6
7
PE-5
PE-6
PE-13


Labour Utilization
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Off-Farm Activities
Farm Work
PE-5
PE-6
PE-13


Household Income
1000 US$/ year
0
2
4
6
8
10
12
Off-Farm Income
Non-Cash Farm Benefits
Net Cash Farm Income
PE-5
PE-6
PE-13


Income Structure
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Off-Farm Income
Non-Cash Farm Benefits
Net Cash Farm Income
PE-5
PE-6
PE-13


Non-Cash Benefits
1000 US$/ year
0,00
0,05
0,10
0,15
0,20
0,25
0,30
0,35
0,40
Marketable Milk (Farm & Household Uses)
PE-5
PE-6
PE-13
Farm Types


Household Living Expenses
1000 US$/ year
0,0
2,0
4,0
6,0
8,0
10,0
12,0
PE-5
PE-6
PE-13
Farm Types

3.3 Farm comparison: Whole farm approach

Farm returns

The farm returns are US$ 3,000, 6,000 and 20,000 per year for PE-5, PE-6 and PE-13 respectively. The smaller farms have returns from crops and other farm activities such as sheep, poultry, and/or guinea pigs, mostly for home consumption with very little being sold. With over 80 percent of the income coming from the dairy enterprises, these farms are highly affected by developments in the dairy industry.

Net cash farm income (NCFI)

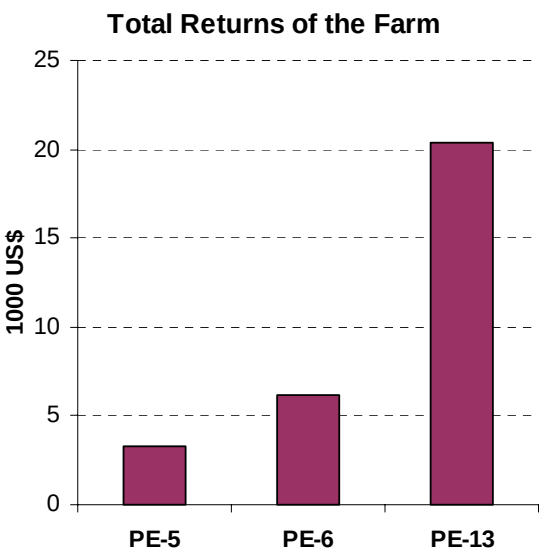
The net cash farm incomes are estimated as US$ 2,000, 3,000 and 6,000 year. All three farms show intermediate to excellent profit margins, which range from a high 70 to a healthy 30 percent. The difference in profit margin can be explained to a large extent by the low-input system of PE-5 which contrasts with PE-13, a farm relying on concentrates and expensive production factors (e.g. land and labour).

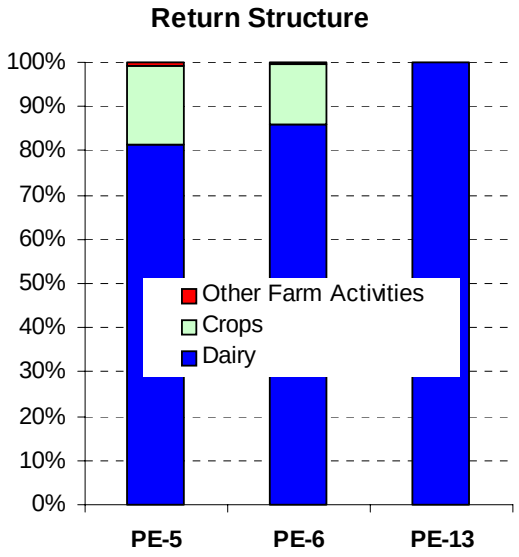
Farm assets

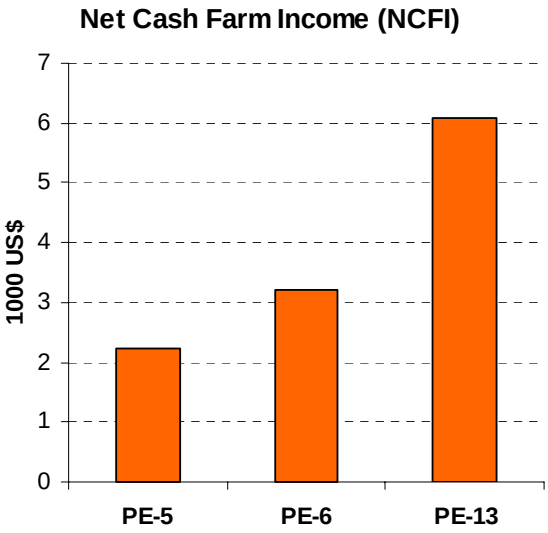
Asset values range from US$ 23,000 to 230,000. On a whole farm basis, land is the most important assets representing about 70 to 90 percent of the farms' asset pool. Land is followed by livestock, which the more relevant asset for the smallest farm as compared to the largest. Other assets refer to machinery, buildings and cash-in-hand. PE-6 has an old tractor, which is used sporadically for the farm, but fully allocated to the farm here as well as the income from renting it out (hardly visible in the graph for returns from other farm activities).

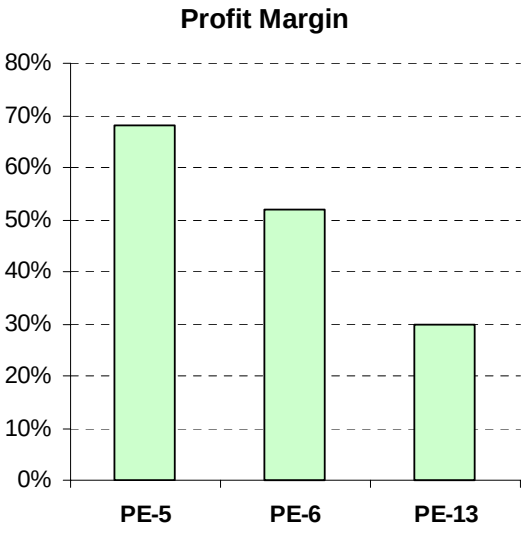
Explanations of variables; year and sources of data:

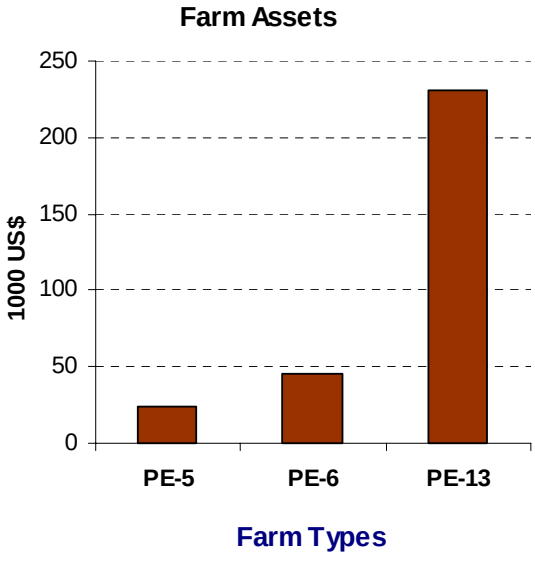
- Total returns: All cash receipts minus the balance of inventory (for example livestock).
- Returns to dairy: Milk, cull cows, heifers, calves, sale and use of manure, draught power, etc.
- Cash crops: Sale of surplus crops like potatoes, beans, maize, etc.
- Net cash farm income (NCFI): Cash receipts minus cash expenses of the farm.
- Profit margin: Net cash farm income divided by total farm returns.
- Farm assets: All assets related to the farm (land, cattle, machinery, buildings, etc.)
- Sources of Data: IFCN database, expert estimations, and statistics, year 2004.

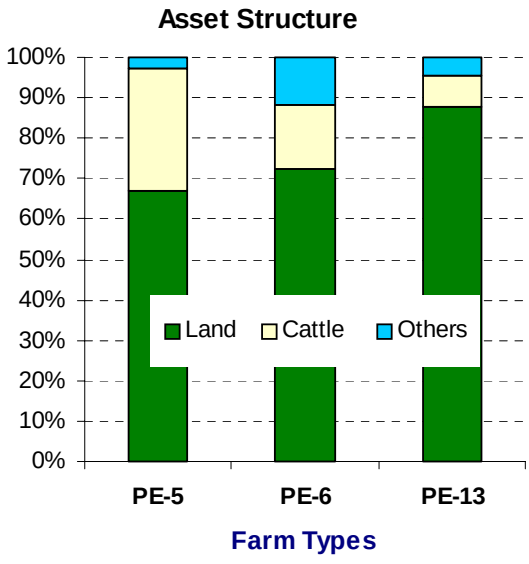

Total Returns of the Farm
1000 US$
25
20
15
10
5
0
PE-5
PE-6
PE-13


Return Structure
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Other Farm Activities
Crops
Dairy
PE-5
PE-6
PE-13


Net Cash Farm Income (NCFI)
1000 US$
7
6
5
4
3
2
1
0
PE-5
PE-6
PE-13


Profit Margin
80%
70%
60%
50%
40%
30%
20%
10%
0%
PE-5
PE-6
PE-13


Farm Assets
1000 US$
250
200
150
100
50
0
PE-5
PE-6
PE-13
Farm Types


Asset Structure
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Land
Cattle
Others
PE-5
PE-6
PE-13
Farm Types

3.4 Farm comparison: Dairy enterprise approach

Cost of milk production

The cost of milk production varies from US$ 28 to 23 per 100 kg ECM. Farm PE-6 has the lowest costs of US$ 23, which is due mainly to both lower feed purchases and no hired labour. On the opposite end, PE-5, using tethering as the predominant grazing practice, has the highest production cost. Tethering requires substantial family labour, which dramatically increases labour costs. This farm may therefore benefit significantly from adopting a more efficient grazing system in order to decrease family labour to the levels of the other two farms.

Return structure

The returns per 100 kg milk range from US$ 29 to 35 for PE-6 and PE-13 respectively. Differences in milk returns can largely be explained by milk price differences. PE-13 sells milk to the School Milk program in the city for a price that is 1.37 times that of PE-6. Non-milk returns are a result of livestock sales. The adjacent graph shows that livestock returns per 100 kg milk of PE-5 are 1.38 times higher than for PE-13. The latter is due to PE-5 achieving comparatively low milk yields. However, the beef prices obtained by PE-13 are about 1.8 times higher than those of PE-5. Furthermore, beef prices in Cajamarca tend to be lower since live animals are gathered, shipped, and finished in the costal regions.

Cost structure of the dairy enterprise

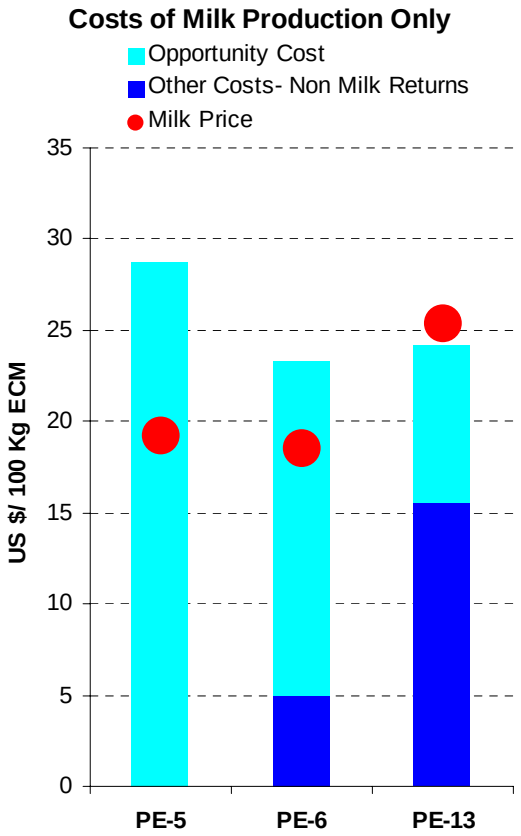
Total costs of the dairy enterprise is 20 percent higher for the smallest farm as compared to the largest. This result is due to high family labour input and low milk yield of the smallest farm.

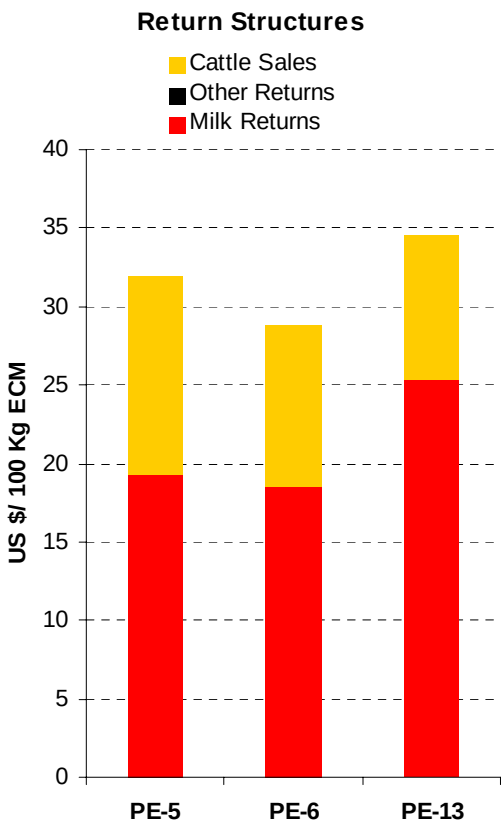
PE-6 has 25 and 40 percent lower labour and concentrates input (respectively) than PE-13.

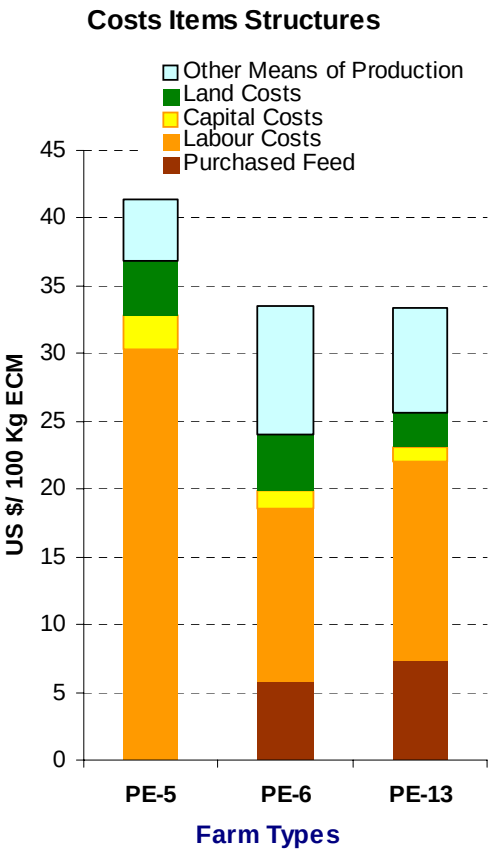
When comparing cash costs, however, PE-13 incurs in 5 and 1.6 times the expenses of the PE-5 and PE-6.

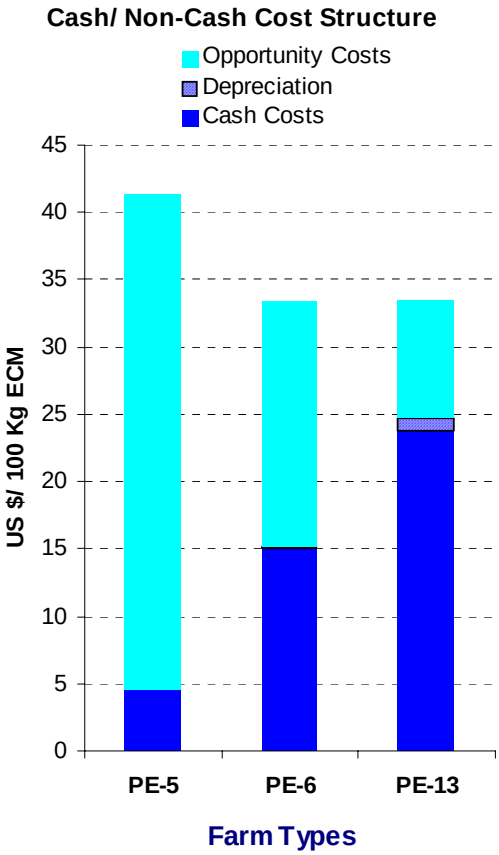
Explanations of variables; year and sources of data:

- Costs of milk production: See Annex A2
- Return structure and cost structure: See Annex A3
- Sources of Data: IFCN database, expert estimations, and statistics, year 2004.


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
35
PE-5
PE-6
PE-13


Return Structures
Cattle Sales
Other Returns
Milk Returns
US $/ 100 Kg ECM
0
5
10
15
20
25
30
35
40
PE-5
PE-6
PE-13


Costs Items Structures
Other Means of Production
Land Costs
Capital Costs
Labour Costs
Purchased Feed
US $/ 100 Kg ECM
0
5
10
15
20
25
30
35
40
45
PE-5
PE-6
PE-13
Farm Types


Cash/ Non-Cash Cost Structure
Opportunity Costs
Depreciation
Cash Costs
US $/ 100 Kg ECM
0
5
10
15
20
25
30
35
40
45
PE-5
PE-6
PE-13
Farm Types

Dairy farm income

All three farm types cover their costs from the profit and loss account and generate a farm income. This income ranges from about US$ 10 to 27 per 100 kg for the largest to the smallest farm.

Dairy profit margin

All farms show excellent dairy profit margins, which range from 70 to 27 percent for the smallest and largest farms respectively.

The extremely high profit margin for PE-5 is mainly due to its reliance on natural pastures as the only feed and using family labour only. PE-6 uses family labour only but purchases concentrate at a rate of 3.6 tons/year. The largest farm uses both purchased concentrates and hired labour.

Entrepreneurial profit

When full economic costs are deducted, the two smaller farms make an entrepreneurial loss of US$ 10 and 5 per 100 kg ECM. The largest farm, however, makes an entrepreneurial profit of US$ 1.20 per 100 kg ECM, which is considered good within IFCN.

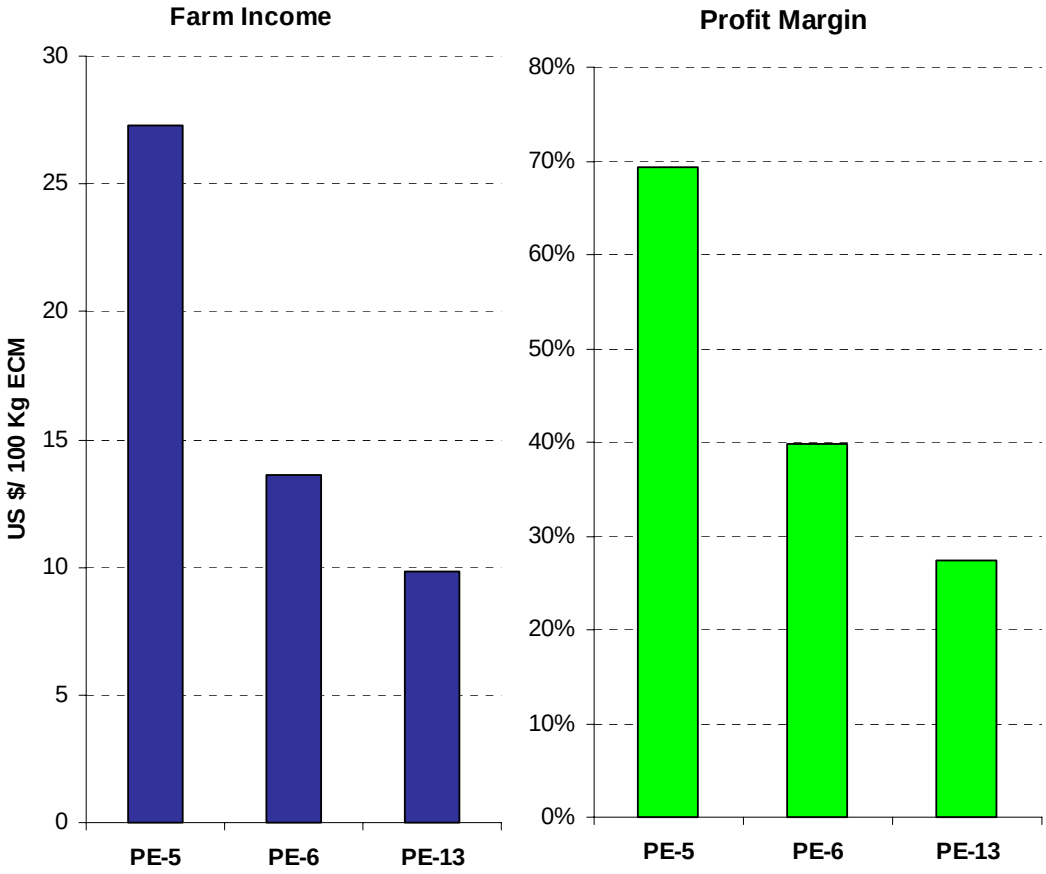
Return to labour

Local wages increase from US$ 0.7 to 1.0 per hour, as the farm location gets closer to the city of Cajamarca. The return to labour from the dairy enterprise varies from US$ 0.5 to 1.2 per hour.

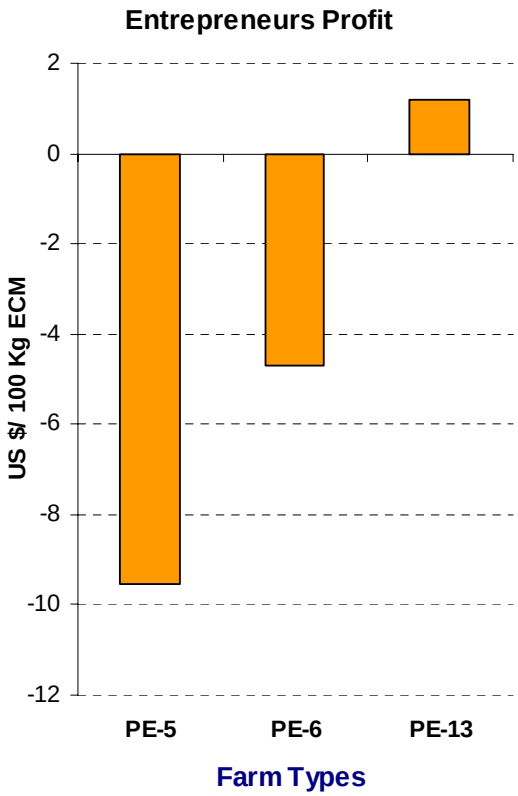
Only PE-13 has returns to labour (wage level earned by working on the dairy farm) that are about US$ 0.10 per hour higher than the wage level around the farm. For the smaller farms, dairy labour returns are still US$ 0.22 and 0.31 per hour lower than the local wage levels.

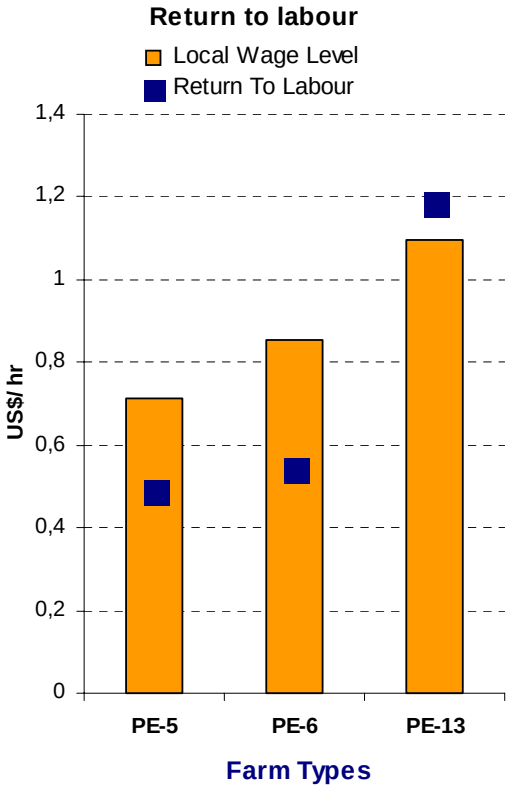
Explanations of variables; year and sources of data:

- Explanations variables and IFCN method: See Annex A2 and A3
- Other returns: None since manure is left on the fields and draught power is contracted in.
- Sources of Data: IFCN database, expert estimations, and statistics, year 2004.


Farm Income
US $/ 100 Kg ECM
30
25
20
15
10
5
0
PE-5
PE-6
PE-13

Profit Margin
80%
70%
60%
50%
40%
30%
20%
10%
0%
PE-5
PE-6
PE-13


Entrepreneurs Profit
US $/ 100 Kg ECM
2
0
-2
-4
-6
-8
-10
-12
PE-5
PE-6
PE-13
Farm Types


Return to labour
Local Wage Level
Return To Labour
US$/ hr
1,4
1,2
1
0,8
0,6
0,4
0,2
0
PE-5
PE-6
PE-13
Farm Types

Labour costs

PE-6 uses an electric fence to graze its animals in cultivated pastures and feeds a small quantity of a complete dairy feed mix. Through these practices, this farm has 35 and 20 percent lower labour inputs per cow than PE-5 and PE-13 respectively.

Due to tethering and low milk yields, PE-5 has 2.5 and 6 times the labour costs per 100 kg ECM of PE-6 and PE-13. PE-5 could, however, cut down its labour costs dramatically by using a more efficient grazing systems, e.g. an electric movable fence like PE-6.

Land costs and 'stocking rates'

Rapid urban growth elevates land prices of PE-13 to 4 to 6 times those of the other farms. However, its much higher milk yield reduces its land costs per 100 kg milk to about half of those for the other farms.

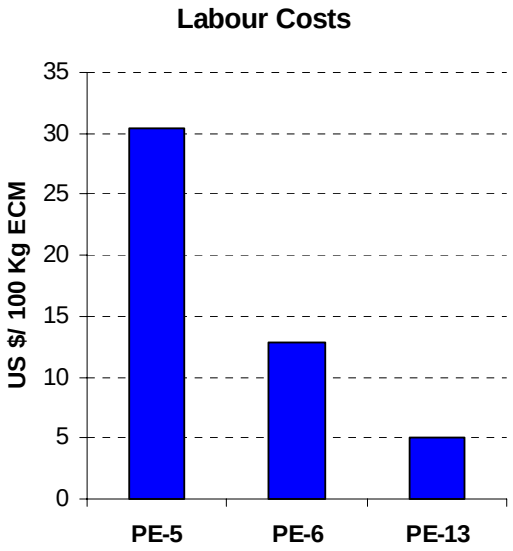
The smaller farms keep one adult dairy animal per ha, which matches well with the typical stocking rates in the higher Sierra (1 Animal Unit / ha). However, some farmers in the same condition double and even triple stocking rate by cultivating better pastures. This is the case of PE-13, which cultivates pastures and maintains 2 cows per ha.

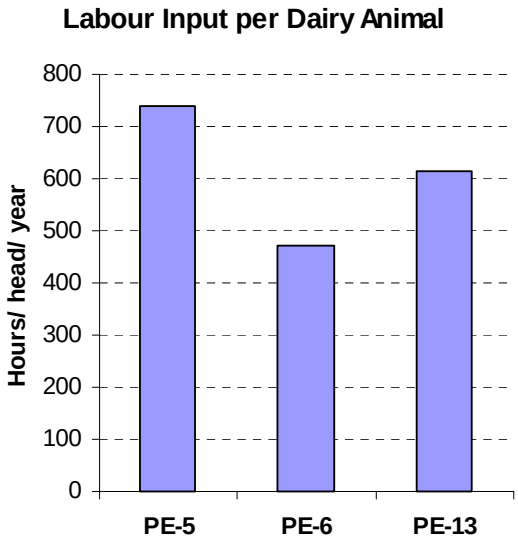
Capital costs

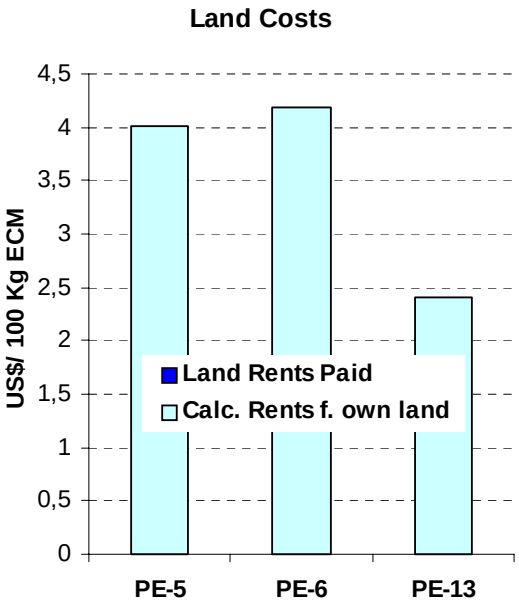
The capital costs per dairy animal are highest in the largest farm due mainly to higher land value, better animal genetics, and investment into building and equipment. However, in terms of capital costs per 100 kg ECM produced, the capital input is highest in the small farm due to its low milk output per year.

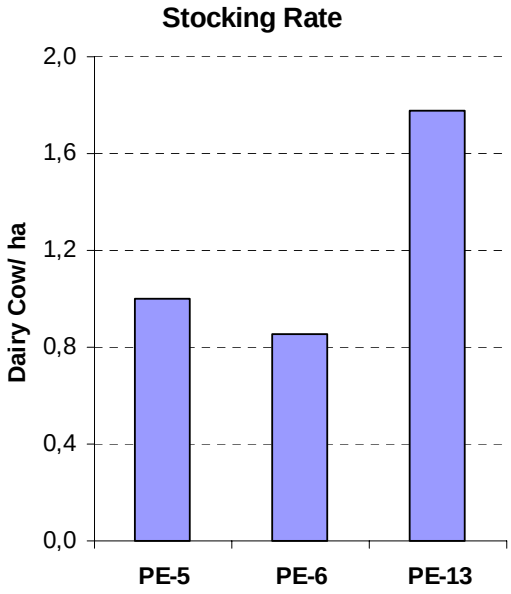
Explanations of variables; year and sources of data:

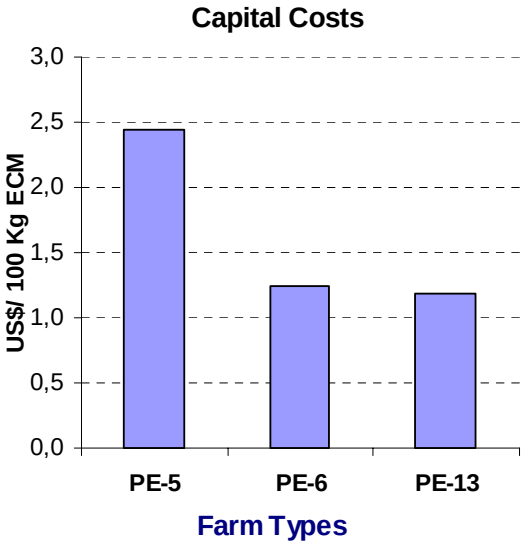
- Explanations variables and IFCN method: See Annex A2 and A3
- Stocking rates: Number of (adult) dairy cows/land size (ha) allocated to the dairy enterprise only.

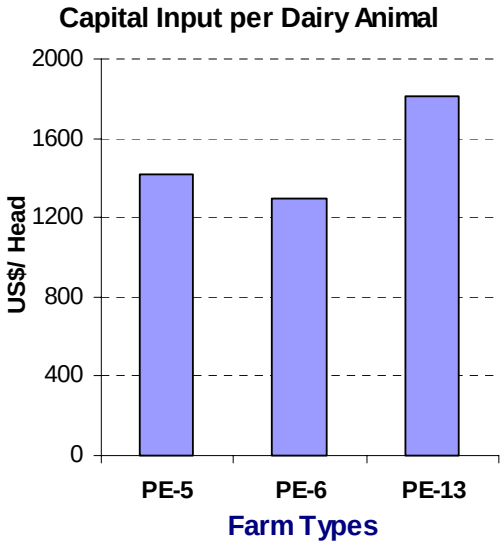

Labour Costs
US $/ 100 Kg ECM
35
30
25
20
15
10
5
0
PE-5
PE-6
PE-13


Labour Input per Dairy Animal
Hours/ head/ year
800
700
600
500
400
300
200
100
0
PE-5
PE-6
PE-13


Land Costs
US$/ 100 Kg ECM
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
Land Rents Paid
Calc. Rents f. own land
PE-5
PE-6
PE-13


Stocking Rate
Dairy Cow/ ha
2,0
1,6
1,2
0,8
0,4
0,0
PE-5
PE-6
PE-13


Capital Costs
US$/ 100 Kg ECM
3,0
2,5
2,0
1,5
1,0
0,5
0,0
PE-5
PE-6
PE-13
Farm Types


Capital Input per Dairy Animal
US$/ Head
2000
1600
1200
800
400
0
PE-5
PE-6
PE-13
Farm Types

4. ANALYSIS OF THE DAIRY CHAIN IN CAJAMARCA

4.1 Main distribution channels for Cajamarca milk

Milk captured by the formal sector

The province of Cajamarca produces an average of 307,187 kg milk per day (Personal communication, August 2005). The formal sector captures close to 75 percent of the milk output while smaller buyers (e.g. cheese-makers) and on-farm consumption accounts for the other 25 percent. In the case of the department of Cajamarca the participation of the informal channels is much larger.

Milk collection in the department of Cajamarca is concentrated in the following four main players: (1) Nestle, which has historically covered much of province of Cajamarca with no direct competition until recently, and still captures the largest share of local milk production; (2) Gloria, with a growing share and large potential to expand its share even more since it is the largest milk processor in Peru and has expanded operations into Bolivia, Ecuador, Argentina and Puerto Rico; (3) small-scale cheese-makers, which capture most of the milk coming from farms whose daily milk output is below the minimum required by the formal sector; and (4) dairy household consumption, which is very low.

Historically, Nestle was the only milk collector in the province, while cheese-makers bought from those farmers not on the collecting routes of Nestle. Farmers consumed little milk since animals had other 'more relevant' purposes such as provision of draught power and as source of savings. However, the milk market has quickly become so competitive that all these four milk buyers / users are now purchasing much of the available milk. Another indicator of a strong milk demand is that the government of Peru imports milk powder for an equivalent of about 380,000 tons of liquid milk per year (an equivalent to US$ 200 million).

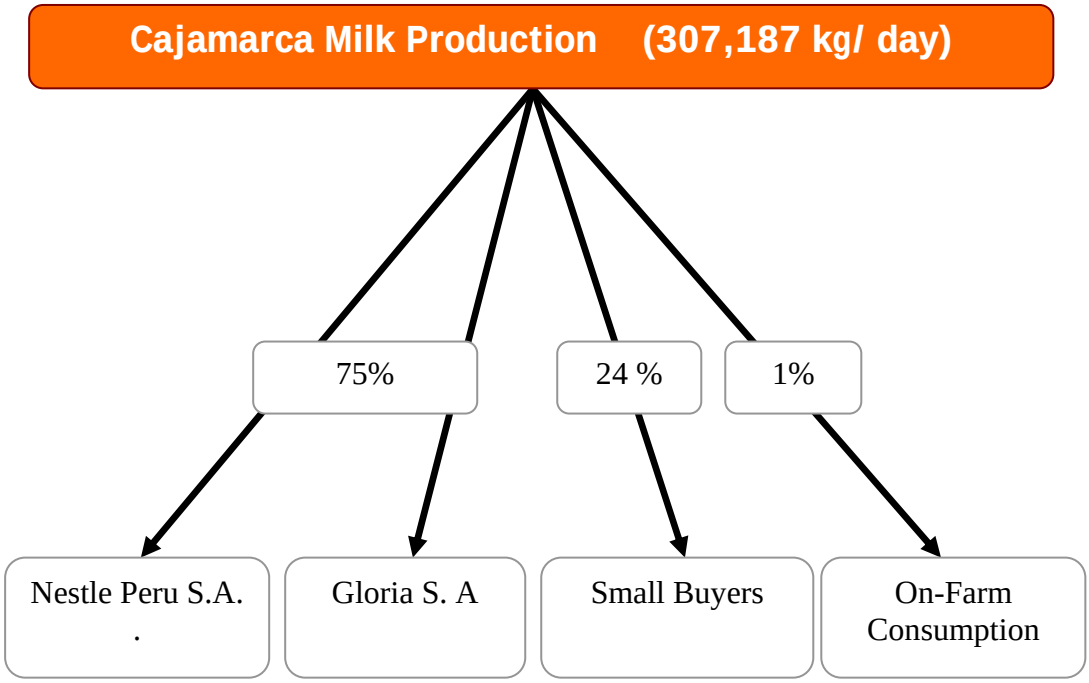
Type of dairy products

With about 76 percent of the dairy market, evaporated milk is by far Peruvians' preferred way to consume milk. Evaporated milk owes its wide acceptance to the fact that it does not need refrigeration and it lasts longer under poor conditions. Although Nestle, Gloria and the government have different market shares in different regions of the country, at the national level Gloria holds approximately 70 percent of the evaporated milk market and 60 percent of the total milk market.

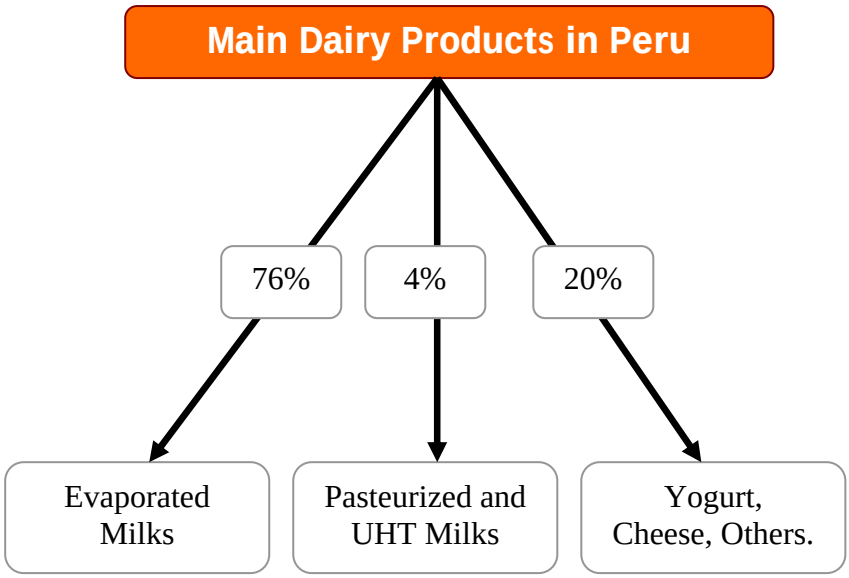
UHT milk is being introduced, but due to a significantly higher price than evaporated milk, its consumers mostly belong to the higher income classes. The high price of UHT seems to be mainly due to the high packaging costs.

Interestingly, in 2003, Peru exported 20,059 tons of evaporated milk to Haiti (8,430 tons), Bolivia (3,354 tons) and Chile (1,066 tons).

Simplified diagram of the milk distribution channels in Cajamarca and main dairy products in Peru



Source: Personal communication with dairy experts in Cajamarca. August, 2005.



4.2 Margins in the dairy chain: Farmer to consumer

In this chapter, the margins in the dairy chain found in the city of Cajamarca are analysed. Due to practicality and comparability among dairy channels, it is assumed that each dairy channel buys one kg of raw (non-corrected) milk, processes it into their most popular dairy product, and sells it to the end-consumer.

Although prices were available, reliable processing details were impossible to obtain. The authors made assumptions based on known facts about dairy processing for similar products (Details in Annex A4). For this reason, these dairy chain calculations should be seen as an exploratory exercise intended to support other sections of this study.

The Dairy Channels

The Formal Sector: Processors collect milk with 3.5 percent fat, condense it (no sugar added) and sell it at 7.5 percent fat, packed in metal cans of different sizes.

The Informal Sector: Local cheese-makers collect milk with 3.7 percent and process it into young fresh cheeses such as *Queso Mantecoso* (the creamy Cajamarcan cheese) and Andean types of Swiss cheese.

Farmer Milk Prices

The cheese-makers (informal sector) pay US$ 0.24 per kg, or 12 percent more than the formal processors (US$ 0.21 per kg) in the Cajamarca valley. The informal sector is known by its fierce price competing tactics wherever needed to retain its shrinking share of milk collected against the expanding formal sector.

Returns of the Dairy Chains

The returns are US$ 0.62 and 0.31 for the formal and informal channels for the original 1 kg milk bought from the farmer. This means that the formal channel makes exactly double the returns of the informal sector. This difference in returns is largely due to the formal sector's higher quality product coupled to a strong demand, while cheese-makers typically offer a low quality product, which is sold to intermediaries.

Margins for Processing and Retailing *(returns of dairy chain – input value of raw milk)*

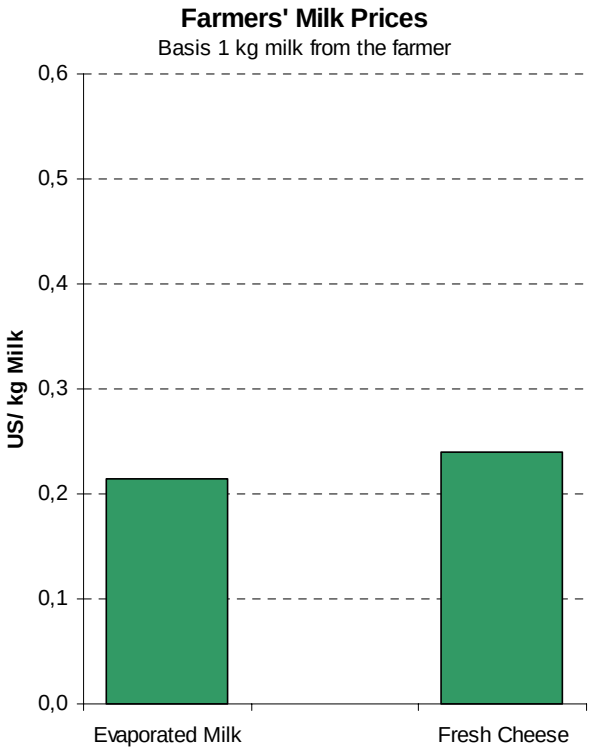
The margins attained from processing and retailing are US$ 0.40 and 0.07 per kg milk for the formal and informal channels respectively. This means that this formal channel has 6 times the margin of the informal channel. The margin (of US$ 0.40 US per kg milk processed and sold) of the formal sector in Peru reaches the (margin) levels of European dairy chains (between US$ 0.30 and 0.50 per kg).

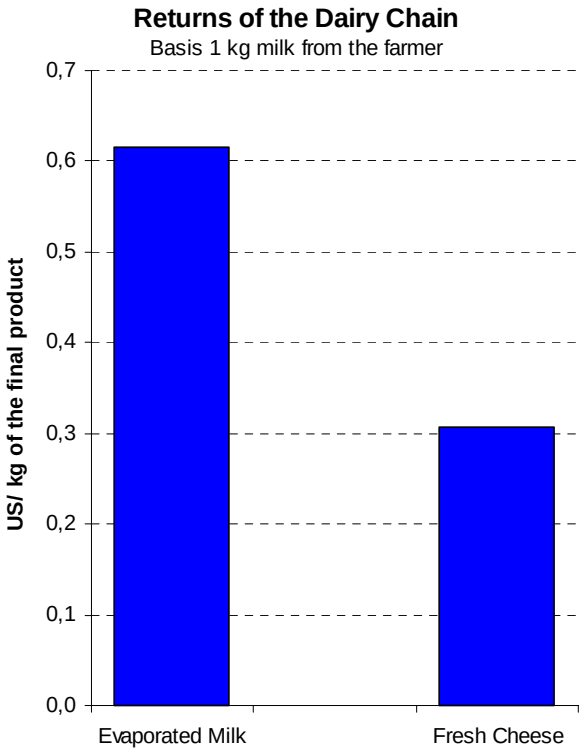
Farmers Shares

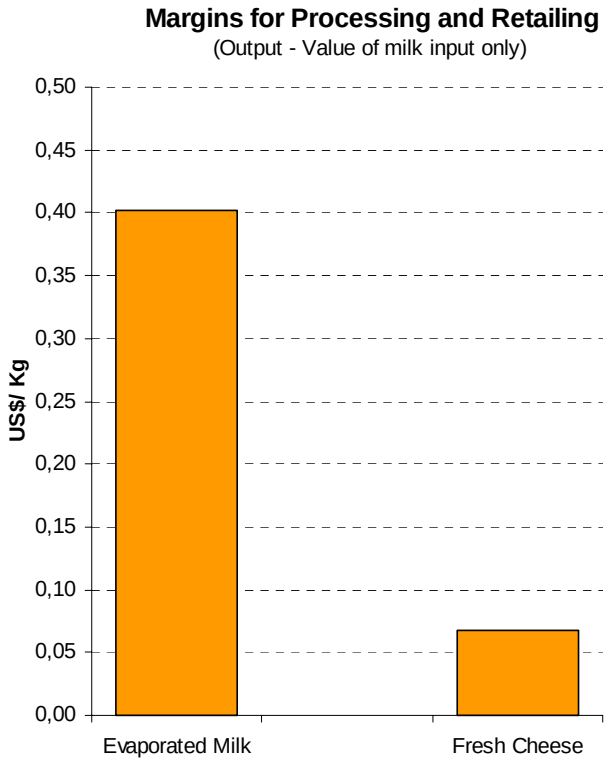
Farmers' shares in the consumer prices are 35 and 78 percent in the formal and informal channels. These results match well with previous studies and the fact that the formal sector has high capacity to add value to its milk, which, in turn, tends to decrease the farmers' share in the consumer price as compared to the informal sector. It is said that small and medium cheese-makers, who make up the bulk of the informal sector, could increase the quality of their products significantly, if they were properly trained.

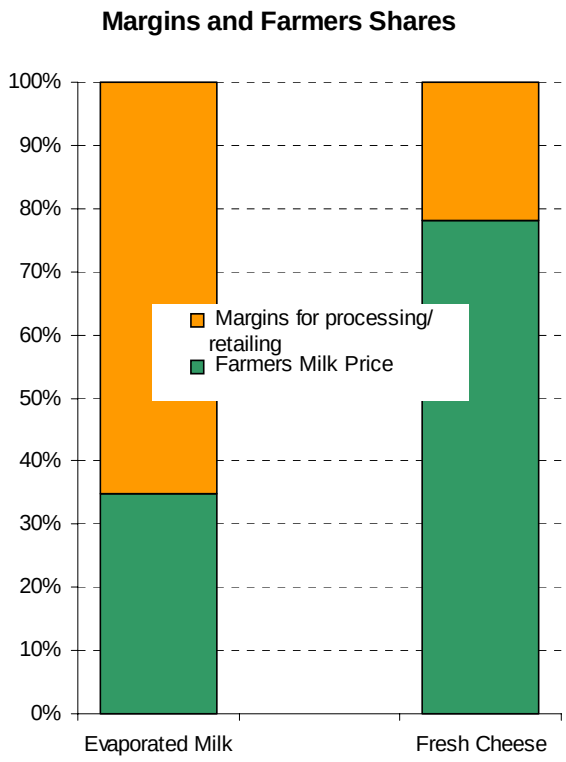
Explanations of variables; year and sources of data:

- For more details on the Dairy Chain calculations, see Annex A6.


Farmers' Milk Prices
Basis 1 kg milk from the farmer
US/ kg Milk
0,6
0,5
0,4
0,3
0,2
0,1
0,0
Evaporated Milk
Fresh Cheese


Returns of the Dairy Chain
Basis 1 kg milk from the farmer
US/ kg of the final product
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0,0
Evaporated Milk
Fresh Cheese


Margins for Processing and Retailing
(Output - Value of milk input only)
US$/ Kg
0,50
0,45
0,40
0,35
0,30
0,25
0,20
0,15
0,10
0,05
0,00
Evaporated Milk
Fresh Cheese


Margins and Farmers Shares
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Margins for processing/ retailing
Farmers Milk Price
Evaporated Milk
Fresh Cheese

5. ANALYSIS OF THE FEEDSTUFFS CHAIN IN CAJAMARCA

5.1 Main distribution channels for feedstuffs in Cajamarca

Dairy farming is being pushed out of the low Cajamarca valley and upwards onto the Sierra. The valley of Polloc, where farm PE-6 is located, represents an excellent example of those higher valleys where dairy farming is expanding. Therefore, these two regions are taken to assess the main feed distribution channels and margins.

Fodder

The typical ration for lactating cows in the department of Cajamarca relies heavily on green fodder, mainly through grazing. Fresh green fodder represents about 90 and 80 percent of daily rations (as fresh matter fed) in the valleys of Polloc and Cajamarca respectively. Polloc shows a competitive advantage to produce green fodder as compared to the lower valley of Cajamarca. However, Polloc farmers pay higher prices for feed items produced on the coast such as molasses (used for the pancamel) and rice straw. This is mainly a reflection of transportation costs and margins made throughout the feed chain.

The table on the next page shows the prices for the most commonly cultivated fodder types. Although the regions count with basic knowledge of fodder cultivation, there is still plenty of room for the optimisation of cultivated pastures, mainly through better pasture management. However, the biggest potential to improve fodder utilization lies on the management of natural pastures or rangelands. The relevance of natural pastures cannot be overemphasized for the following three main reasons: (1) about 40 percent of the land area of the department of Cajamarca, which is around 665,000 ha, are estimated to be under natural pastures; (2) natural pastures are mainly used by the masses of the poorest Peruvian farmers and collective herders. Improvements in the management of natural pastures will have a direct impact on the profitability of the typical Andean dairy farm; and (3) small scale farmers do not only rely on natural pastures, but they will have difficulties adopting cultivated pastures. The main reasons given for the latter are that cultivating pastures competes with food crops for arable land, and that it requires inputs, which are both not easily available and must be paid for in cash.

Concentrates

The typical dairy farmers in Polloc and the valley of Cajamarca feed some concentrates to complement the pasture-based ration. When feeding concentrates, about 70 and over 95 percent of the farmers, in the respective areas, prefer to feed a balanced feed mix rather than separate feed items, which is also practiced.

Whole ration

Based on the nutritive composition of the ration components (seen in the next table), in Polloc one US$ purchases 1.23 and 1.07 times the net energy for lactation (Mcal) and crude protein (in grams) as compared to in Cajamarca. This confirms that Polloc has a slight advantage in feed costs over the lower valley of Cajamarca. Finally, one should note that innovations, which are prevalent in the province of Cajamarca, tend to increase dairy farming competitiveness mainly through improving feed efficiency. An example is the project of PROPIAGA, S.A., which implements the concept of 'Total Mixed Ration' using mostly local feed ingredients.

Feed types and costs in Cajamarca, Peru

Order	Item	Origin	Valley of Polloc				Valley of Cajamarca			
			% Fed	Prices (US$/ Kg)			% Fed	Prices (US$/ Kg)		
				Farmer	Distributor 2	Distributor 1		Farmer	Distributor 2	Distributor 1
Fodders										
1	Rye Grass	National	40	0,01	0,01	0,01	44	0,02	0,02	0,02
2	Oats	National	4	0,03	0,03	0,03				
3	Penisetum grass	National	27	0,01	0,01	0,01	10	0,01	0,01	0,01
4	Alfalfa	National	5	0,06	0,05	0,05	8	0,06	0,05	0,05
5	Pancamel **	National	10	0,15	0,13	0,11	13	0,14	0,13	0,11
6	Trifolium red	National	1	0,05	0,05	0,05	3	0,05	0,05	0,05
7	Rice Straw	National	1	0,09	0,07	0,05	2	0,08	0,07	0,05
Concentrates										
8	Fish meal	National								
9	Soybean cake	Imported								
10	Corn (ground) ***	50 - 50								
11	cottonseed (whole)	National								
12	Cottonseed meal	National	12	0,27	0,24	0,21	20	0,26	0,24	0,21
13	Molasse	National								
14	Premixes ****	Imported								
15	Salt	National								
16	Wheat middling	Imported								
Total *****			100				100			
Feed costs per kg.				**0,061**	**0,055**	**0,048**		**0,089**	**0,083**	**0,074**
Energy Metabol. (Mcal/ Kg)			2000				2300			
Protein (%)			11				14			

Notes:

* : this evaluation was done for top managed farms in the respective zones .

** :consists of corn stover (60%) and cane molases (40%).

*** :ground corn is about half produced nationally and other half imported.

**** :vitamines and/or minerals.

***** : %ages of feed fed as fresh in the surveyed farms.

Exchange rate used: 1 US$ = 3.51 Peruvian Nuevo Sol.

Source: Prepared by MS. Nicolas Caballero (on Nov. 07, 2005).

5.2 Margins in the feed chain: Manufacturer to farmer

This section analyses the margins in the main feed distribution channel serving dairy producers in the valley of Polloc, Cajamarca. For this exercise, the authors faced data quality challenges stemming from a lack of awareness on the processing methods and nutritive values of these feeds as well as the seasonal price variation. For practical purposes, the authors made assumptions based on knowledge about similar methods, products, and regions. In view of these challenges, these dairy feed calculations should be seen as an exploratory exercise only, intended to support other sections of this study.

The dairy channels

Balanced Feed Mix: Consists of at least 18 percent crude protein and 1.64 Mcal NE_L per kg. This balanced feed is mixed in Lima, where imported ingredients arrive. Then, it is either used by peri-urban dairy farms around Lima or sent by land to milksheds such as Arequipa, Cajamarca, Libertad, etc. The main feed manufactures are Purina and Alicorp, both competing for the dairy feed market in Cajamarca.

Single Feed Ingredients: The main feed ingredients are wheat middling, cottonseed meal as well as the vitamin and mineral Premixes. Farmers purchase them separately and then mix or feed them in a per cow basis. These ingredients can be divided into two main groups, (a) mainly imported ones such as wheat and the vitamin and mineral premixes, and (b) the nationally produced cottonseed meal.

Feed prices received by the primary distributors (in Lima)

The primary distributors in Lima sell the most popular dairy balanced feed mix, wheat middling, and cottonseed meal for US$ 0.21, 0.12, and 0.21 per kg respectively.

Feed prices paid by dairy farmers (in Polloc, Cajamarca)

Farmers in Polloc pay US$ 0.27, 0.17, 0.29 per kg of their most fed balanced feed mix, wheat middling, and cottonseed meal respectively. These prices do not include the farmer's labour and transport cost from the local distributor to the farm-gate, which was estimated to vary between US$ 0.02 and 0.05 per kg feed.

Retail margins and transportation costs (Farmers price – Primary distrib. price)

The margins attained from transportation and retailing are US$ 0.06, 0.05, and 0.08 per kg feed for the balanced feed mix, wheat middling, and cottonseed meal.

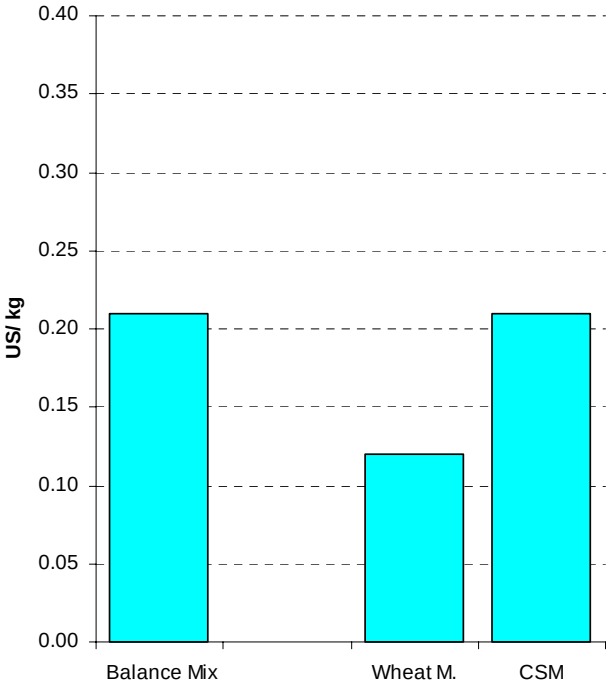
Retail shares in dairy farmer feed prices

Transportation costs and margins for intermediaries along the chain amount to 22 to 29 percent of the farmers' feed prices in Polloc. Feed costs are the major costs of any dairy farm and both of these margin categories are worth examining in more detail in order to identify approaches that could decrease feed costs by creating a more efficient feed distribution mechanism.

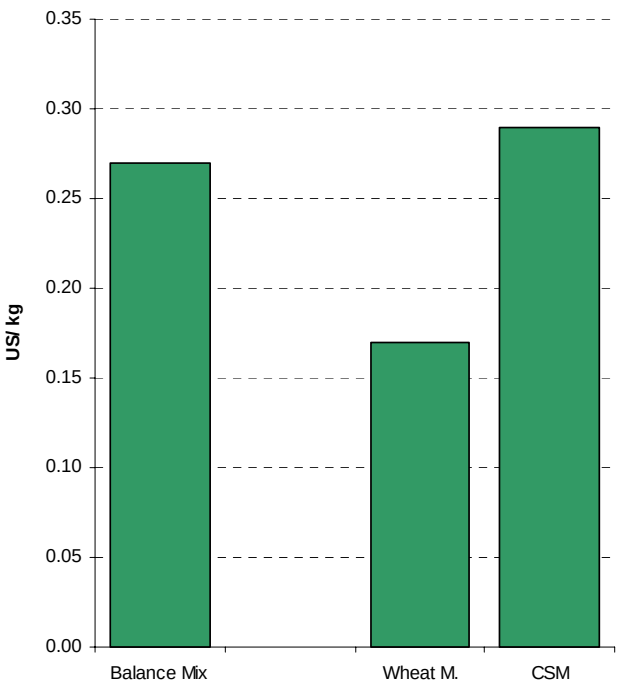
Explanations of variables; year and sources of data:

- Wheat M.: is Wheat Middlings.
- CSM: is Cottonseed Meal.
- NE_L: is Net Energy of Lactation.

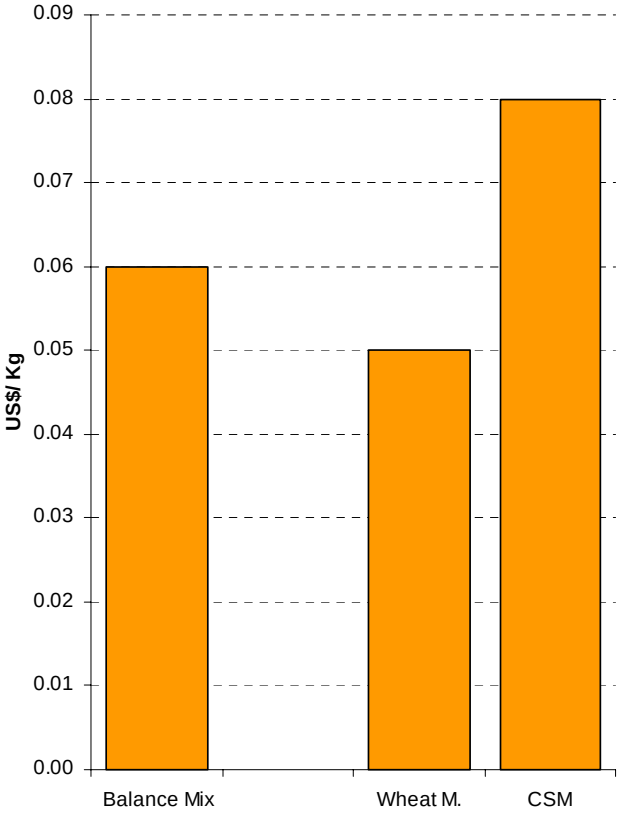
Feed Prices paid by Distributors in Lima



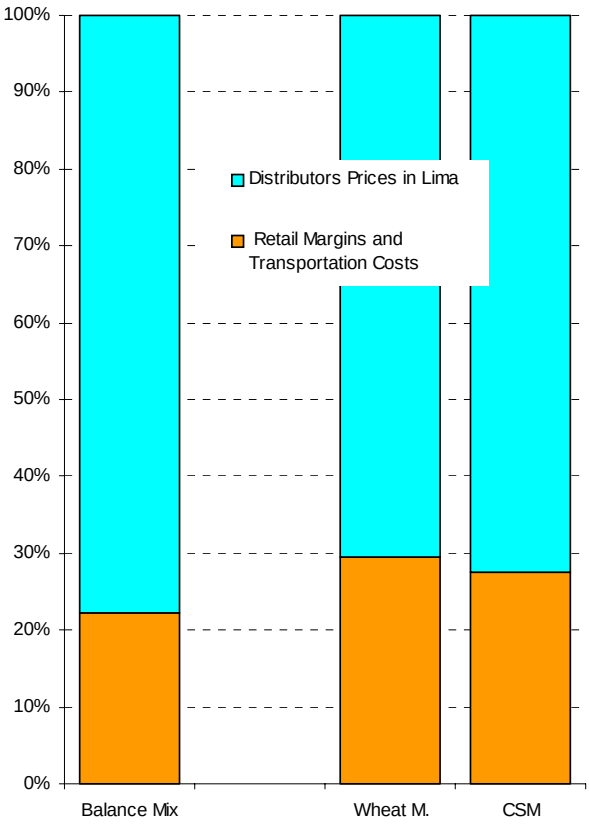
Feed Prices paid by Farmers in Polloc



Retail Margins and Transportation Costs
(Farmer Prices in Polloc - Distributor Prices in Lima)



Shares in the Farmer Feed Prices
(in Polloc, Cajamarca)



CONCLUSIONS

Current contribution to household income

A World Bank report (Werbrouck, 2004) stated that inequality in Peru has decreased, not because income has increased among the poor, but rather because of impoverishment among the rural middle classes. The report also states that the average daily *per capita* income for households in the rural sierra, urban sierra, and whole of Peru are US$ 1.3, 4.2 and 3.1. As comparison, this study shows that typical dairy households in the Cajamarcan sierra have daily *per capita* incomes of US$ 1.5 and 2.0 for PE-5 and PE-6, both located in the rural sierra. For the urban sierra location, PE-13 shows a daily *per capita* income of US$ 9.5, which is more than double and triple the urban sierra and national average quoted by the World Bank. (Much if this is due to PE-13 off-farm income.)

It should also be noted that PE-5 and PE-6 not only have above average incomes for the region but also that these income are provided to 100 and 80 percent by the farming activities, which in turn are derived to 80 and 85 percent by their dairy enterprises. Therefore, dairy is by far the single most important source of income for these households. A well orchestrated dairy development intervention could therefore have significant impacts on improving the people's livelihood in the Peruvian rural sierra and the greater Andean region.

Potential dairy contribution to household income

The incidence of poverty (67 percent) and extreme poverty (40 percent) is highest in rural areas, reaching 73 and 41 percent respectively in the sierra (Werbrouck, 2004). The two smaller farms in this study fall close to this 73 percent of the sierra inhabitants living in poverty. These farm types also represent 99 percent of the dairy farms, hold 90 percent of the cows, and produce the bulk of the milk in the department of Cajamarca. They have great potential to increase milk production and farm profitability through various approaches and interventions.

On the demand side, Peruvian milk imports account for 380,000 tons per year, for an expenditure of US$ 200 million. Furthermore, experts in the processing sector estimate that the national market has the potential to grow by 2 million tons per year in the coming years. They also fear that milk powder prices will increase in the coming years due to further reduction of export subsidies in industrialized countries. This will likely increase the comparative advantage of domestically-produced milk over imported milk.

As a conservative illustration, if only half of the national milk imports were procured from the 105,000 existing dairy farms, this would result in an increase in output of about 2,000 kg per year per farm. For PE-5 this would mean that it should increase milk sales by 25 percent, which is possible through improved management without major cash investment. With a milk price of US$ 0.20 per kg and 70 percent profit margin, PE-5 would thereby achieve a daily *per capita* income of US$ 1.71, or a 13 percent increase. This indicates that for PE-5, a one percentage point increase in sales leads to half a percentage point increase in daily *per capita* income. To ensure that small farms in the sierra can capture a share of the growing market, policymakers should to keep a close eye on the following aspects of the dairy industry (among others): (1) profitability at the farm level and (2) efficiency of the farm input (e.g. feeds) and output (e.g. milk and beef) chains.

Dairy farming in Cajamarca

The total cost of milk production varies from US$ 23 to 28 per 100 Kg ECM. Farm PE-6 can produce milk at US$ 23 because of lower labour costs for family labour. However, when only cash costs are considered, PE-5 has no costs (due to using family labour and natural grasses only) while the other two farms have cash costs of US$ 5 and 15 per 100 kg ECM (purchased concentrates and inputs for cultivated pastures).

The returns between the farms range from US$ 29 to 35 per 100 kg milk. Differences in milk returns can be explained by farm location in relation to the city of Cajamarca, milk quality (bonuses for fat content, acidity and tuberculosis and brucellosis status), and farmer's milk price negotiating power.

Differences in cattle returns are mostly due to genetic differences (the larger farm sells highly-valued breeding bulls).

There is much potential for the two smaller farms to increase milk production by better forage/pasture management and utilization. In particular, PE-5 should look at improvement through better genetics, pasture and herd management (lower mortalities, age at first calving and inter-calving periods), and farm diversification into complementary activities (e.g. sheep production).

Dairy chain in Cajamarca

Milk collection in Cajamarca is concentrated in the following four main players: (1) Nestle, which has historically covered much of province of Cajamarca with no direct competition until recently, and still captures the largest share of the milk collected; (2) Gloria, which has a significant potential to capture and process local milk since it is the largest milk processor in Peru and has expanded operations into Bolivia, Ecuador, Argentina and Puerto Rico; (3) small-scale cheese-makers, whose milk collected share is shrinking; and (4) own household consumption, which, for Peru, is at a low of 50 kg per year per person, the second lowest in South America.

Producer milk prices are US$ 0.21 and 0.24 per kg in the formal and informal sectors respectively. However, the consumer price (for the original kg of raw milk) is double for the formal sector's evaporated milk (long lasting and well established acceptance). The margins attained from processing and retailing are US$ 0.40 and 0.07 per kg milk in the formal and informal channels.

Lastly, farmers' shares in the total consumer prices are 35 and 78 percent in the formal and informal channels. In similar studies in Asian countries, farmers' shares are lower in both channels (below 30 percent in the formal sector). It is estimated that cheese-makers could increase their profitability and maintain their higher milk prices paid to farmers if they were better trained. This is a point worth exploring in further research and intervention.

Feed chain in Cajamarca

Dairy farmers in Cajamarca prefer to feed a balanced commercial feed mix. Some feed their own mixture of feed ingredients such as wheat middling (90 percent of imported wheat), cottonseed meal (domestically produced), and mineral and vitamin premixes (80 percent of ingredients imported).

Estimates from this study are that 22 to 29 percent of the feed price paid by farmers are to cover costs of transportation and retailing from the primary distributor in Lima to the farms in Polloc, Cajamarca. The poor conditions of the road system linking the highlands to the coast and its vulnerability to bad weather makes the transportation of inputs into the highlands difficult for the dairy industry. Clearly, the dairy farmers

in Cajamarca, as well as the rest of the economy, would benefit greatly from both better road infrastructure and fewer intermediaries in the feed chain.

A1: METHODOLOGICAL BACKGROUND

In this chapter, we will present the methods and sources of information used to collect data about the dairy sector in Cajamarca 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 2004, the number of participating countries extended to 31 countries with 86 farm types that represent more than 70 percent of the world milk production.

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

The central objectives of IFCN are:

1. To create and maintain a standardised 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 analyse the impact of the structure of production, technology applied and country-specific policies on the economic performance of agribusinesses, 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 utilised 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 reorganise 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 generalise 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. Such models will be preferred by analysts. The model TIPI-CAL (Technology Impact and Policy Impact Calculations) is utilised 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 optimisation). 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 realised 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. 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, analyse 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 farm models follow the same structure as those in the 'IFCN Annual Dairy Report'. The main objectives of this report are a) to analyse the main typical milk production systems in the region of Cajamarca and b) to describe and briefly evaluate the most typical channels for feedstuffs as concerning these farms.

For more information about IFCN, visit http://www.ifcnnetwork.org and http://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 NZ), the land market value was capitalised 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 percent.

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 ECM (4 and 3.3 percent fat and protein)

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

Farm Economic Indicators (IFCN Method)

+ Total receipts =

+ Crop (wheat, barley, etc.)
+ Dairy (milk, cull cows, calves, etc.)
+ Government payments

- Total expenses =

+ Variable costs crop
+ Variable costs dairy
+ Fixed cash cost
+ Paid wages
+ Paid land rent
+ Paid interest on liabilities

= Net cash farm income

+ Non cash adjustments =

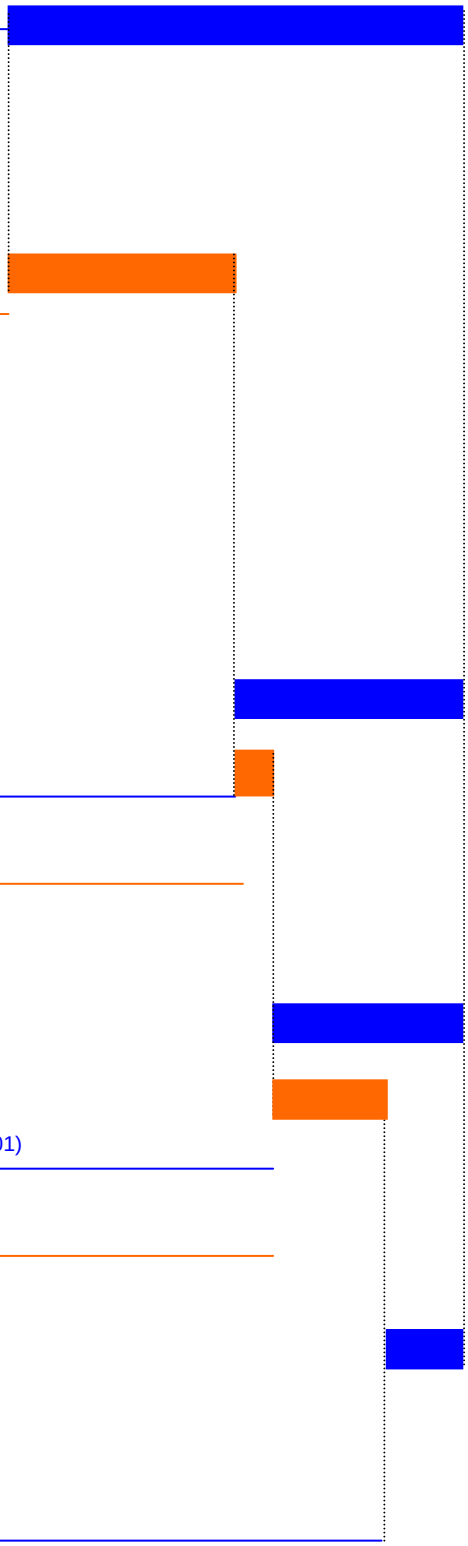
- Depreciation
+/- Change in inventory
+/- Capital gains / losses

= Farm income (Family farm income in Dairy Report 2001)

- Opportunity costs =

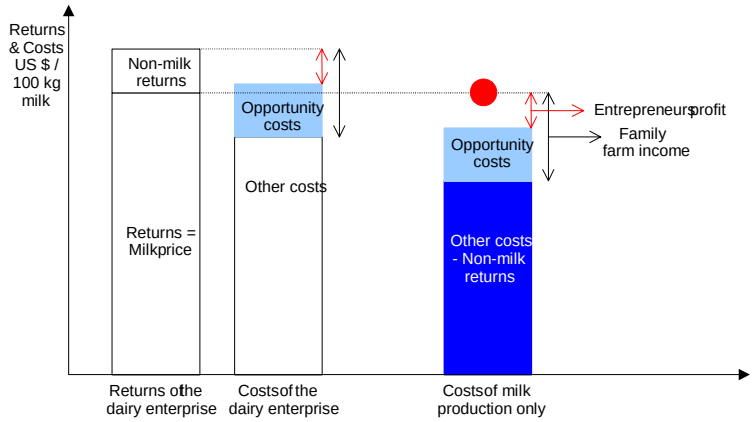
+ calc. interest on own capital
+ calc. rent on land
+ calc. cost for own labour

= Entrepreneurs profit



A3: DESCRIPTION OF IFCN RESULT VARIABLES

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 price: Average milk prices adjusted to fat corrected milk (4 percent 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, fertiliser, 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, fertiliser, 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, and 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 cows / ha land.

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: DAIRY CHAIN CALCULATIONS

		Formal Sector	Informal Sector
		Industry	Milk collector
Variables	**Units**		
Dairy Processing based on 1 kg milk bought from the farmer			
Main Processed Dairy Products	Description	**Evaporated Milk**	**Fresh Cheese**
INPUTS			
1- Milk from the farmer			
Quantity Flowing into the Chain	Kg	1.00	1.00
Fat Content	% estimation	3.50	3.80
Protein Content	% estimation	3.50	3.60
FARMERS MILK PRICES	US$	0.21	0.24
OUTPUTS			
Main Product	Description	**Evaporated Milk**	**Fresh Cheese**
Quantity	Kg	0.41	0.15
Fat Content	%	7.5	30
Protein Content	% estimation	6	25
Retail Price	US$/ Kg	1.5	2.0
TOTAL CONSUMER PRICES	**US$**	0.62	0.31
MARGINS			
Sum of all Returns	US$	0.62	0.31
-Farmers Milk Price	US$	0.214	0.240
FINAL MARGINS	**US$**	**0.40**	**0.07**

Notes:

For these calculations, we assumed to have taken 1 kg milk; paid local milk market prices; processed it (local prices for inputs) to produce the main product, and retailed all the outputs locally to get the total consumer prices.

Processing details were not available and authors' assumptions were made based on similar analyses.

Local cheesemakers estimate that 6.5 kg milk yield 1 kg of fresh cheese.

Exchange rate used: 1 US$ to 3.51 Soles.

A5: FEED CHAIN CALCULATIONS

		Balance Feed Mix	Feed Ingredients	
Main Feed Products	Description	**Balance Mix**	**Wheat Middling ***	**Cottonseed Meal**
Codes for the graphs		Balance Mix	Wheat M.	CSM
Start Point				
1- In Lima				
Feed Manufacturer	Description	**Feed manufacturer**	**Wheat mill**	**Cotton oil extractor**
Primary Distributors' Prices	US$/ kg	0.21	0.12	0.21
Crude Protein Content **	% estimation	18.00	-	-
Net Energy Lactation **	Mcal/ kg	1.64	-	-
Import share of Raw Materials ***	% estimation	60	90	0
Type of transportation to CAJ.	Description	Trucks	Trucks	Trucks
Middle Point				
2- In Cajamarca				
Secondary Distributors' Prices	US$/ kg	0.24	0.15	0.25
Finish Point				
3- FARMER PRICES				
Prices for Farm PE-6	**US$/ Kg**	0.27	0.17	0.29
MARGINS				
First Distributor Feed Price	US$	0.21	0.12	0.21
Farmers Paid Feed Price	US$	0.27	0.17	0.29
FINAL MARGINS	**US$**	**0.06**	**0.05**	**0.08**

Notes:

1- For these calculations, we identified the main feeds used by typical farms in the town of Polloc and then we gathered their prices at the origin of the chain (Lima) and the user-end (PE-6 farm types).

2- CAJ refers to Cajarmaca.

*: Wheat middling: National Research Council, Nutrient Requirements of dairy cattle (2001)

**: Dry Matter Basis

***: Wheat 90% imported but milling is done in Peru

Exchange rate used: 1 US$ = 3.51 Nuevo Soles.

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Other references appear at the bottom of the pages where tables and graphs are shown.