Chapter 4

International Competitiveness of ‘Typical’ Dairy Farms

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4.1 Summary

Introduction

This chapter compares the international competitiveness of ‘typical’ dairy farming systems in selected countries, with special focus on the cost of milk production and main determinants thereof. It also seeks to determine whether small-scale dairy farms in developing countries are in a position to compete with large-scale dairy farming systems in industrialized countries.

Farm types and data

Thirty dairy farm types from 13 countries have been compared using the standard IFCN methodology. Farms representative of various dairy farming systems were selected in Bangladesh, Cameroon, China, India, Morocco, Pakistan, Peru, Thailand, Uganda and Viet Nam and subjected to detailed analysis. For the industrialized countries, similar analyses were conducted for farms in Germany, New Zealand and the USA. In general, the first farm ‘type’ represents the current ‘average’ farm, while the second represents either a larger farm type or a different, but relevant, dairy production system. A detailed description of the farms appears in Annex 5.

While production data usually refer to the calendar year 2005, data for the farms in Africa and China were obtained in 2006 when they entered the IFCN data collection system. For the farms in India (Orissa and Karnataka), Thailand and Viet Nam, the data were obtained in 2004. In order to make use of available information, 2005 exchange rates were applied to all financial farm data.

Comparison of dairy returns

Dairy farm returns derive from milk and/or non-milk items (sales of cattle and manure, government payments, etc.). Milk returns account for 55 to 95 percent of the returns of all farm types analysed, and range from US$12 to US$36/100 kg of ECM. These returns are mainly determined by three categories of farmgate milk prices, which were:

- **Less than US$20/100 kg**: Observed in Pakistan and Uganda.
- **US$20-30/100 kg**: Although most farms receive prices in this range, those in India, New Zealand Viet Nam are at the lower end of the range whereas prices in Bangladesh and Thailand are at the higher end.
- **More than US$30/100 kg**: Farmers in Cameroon, Germany, Morocco and the USA all obtained similar milk prices of about US$36/100 kg of ECM.

Non-milk items account for US$2 to 38/100 kg ECM of the returns of the dairy farm types analysed. The main determinants of non-milk returns were the cattle/beef price levels; culling rates and, related to that, strategies for selling calves and surplus heifers; yields per lactation; the level of government payments coupled to milk production; and use of manure on the farm. Based on these factors, non-milk returns were very low for the farms in India and very high in Germany and Morocco.

Comparison of the cost of milk production

Lowest milk production costs (less than US$12/100 kg) were observed for both farm types in Uganda and for the larger farm type in Cameroon. Production costs on all farm types in China, New Zealand, Peru, Thailand and the USA were slightly higher (US$22 to 30/100 kg), but were highest in Germany (over US$35/100 kg).

Given major differences in agricultural wage rates between developed and developing countries, it might be assumed that developing country farms have a labour cost advantage. It is, however, interesting to note that this was found not to be the case when comparing labour costs per litre of milk, mainly because as a general rule regions with higher salaries also have a significantly higher level of labour productivity. Expressed in terms of per litre of milk, the labour costs of a nine-cow dairy farm in Punjab, India, are similar to those of a 350-cow farm in the USA. The key cost advantage of smallholder dairy farming is the use of low-cost feed and the overall ‘low-tech’ approach to milk production. Cows fed on crop residues, such as straw, are lower-cost producers of milk than high-yielding, grain-fed dairy cows.

Economies of scale

In general, comparison of farm types within and across countries and regions supports the hypothesis that economies of scale exist in milk production. It was observed that in Thailand and Uganda lower milk production costs were incurred only by the smaller farm types, mainly because of their significantly higher non-milk returns per 100 kg of milk.
Cost comparison between developed and developing countries

To obtain a clearer understanding of their comparative position in terms of international and local competitiveness, a simple average of key indicators of competitiveness was calculated for farmers in both developing and developed countries. Although the method is very crude and there are very large variations within each group, the comparison is most informative.

Average milk production costs in the three developed countries covered by this study (Germany, New Zealand and the USA) stand at US$31.4/100 kg, or 56 percent above the average production cost of US$20.2/100 kg calculated for the ten developing countries (Bangladesh, Cameroon, China, India, Morocco, Pakistan, Peru, Thailand, Uganda and Viet Nam). The average price of milk in the three aforementioned developed countries (US$31.2/100 kg) is only 30 percent higher than that of the developing countries (US$24.0/100 kg). Thus, the overall profitability of milk production appears to be higher in developing countries than in the developed ones, which may be one of the reasons why developing countries are increasing their shares in global dairy production.

Returns to labour

If dairy farming is to be sustainable, it is essential that it should be able to compete for labour on the local labour market. The indicator ‘return to labour’ quantifies the ‘value-added’ per hour of labour put into dairy farming. If this return is higher than the average local wage rate, then the farming system can afford to pay competitive wages and should be sustainable from the labour standpoint. The average return to labour observed in the developing countries covered by this study is US$0.45/hour, which is 45 percent higher than the average local wage of US$0.31/hour. In the three developed countries, the average return to labour is US$16.30/hour, which is still 22 percent above the average estimated wage of US$13.30/hour. These figures indicate that dairy farming can compete on the local labour market in both groups of countries. However, despite these favourable returns to labour from dairy farming, the figures also show that milk production can quickly lose its competitive advantage if local wages rise faster than labour productivity.

Impact of increasing feed prices on competitiveness

Given the rapid increases in feed prices over the recent past, it is important to consider how this affects the small-scale dairy farmers in developing countries in terms of competitiveness. In general, as these smallholder dairy systems normally use much less compound feed per kilogram of milk produced than dairy farms in the EU and the USA, rising feed prices increase the cost of milk production in the latter countries much faster than in the low-yield systems predominating in the developing countries. As a result, small scale dairy farming becomes even more competitive as feed prices increase.
4.2 Overview of selected dairy farm types

**Introduction**

Typical farms were selected in accordance with the following rationale: the first (small) farm type of each country was chosen to represent the dairy herd size closest to the statistical average. Other farm types were selected as representing larger farms in order to assess economies of scale in the different countries, or as representing different dairy production systems. Management levels on the typical farms selected were average-to-slightly-above-average in relation to other farms in the same country.

**Overview of farm characteristics**

The table below provides a succinct overview of the types of dairy farm included in the analysis. Further details on each farm are provided in Annex 5.

<table>
<thead>
<tr>
<th>Country</th>
<th>Farm1</th>
<th>Farm land (ha)</th>
<th>Dairy herd size2</th>
<th>Milking</th>
<th>Annual milk yield (kg)3</th>
</tr>
</thead>
<tbody>
<tr>
<td>India (Orissa)</td>
<td>IN-2OR</td>
<td>2.0</td>
<td>2 buffaloes</td>
<td>Hand</td>
<td>450</td>
</tr>
<tr>
<td>India (Punjab)</td>
<td>IN-6OR</td>
<td>1.0</td>
<td>6 buffaloes</td>
<td>Hand</td>
<td>1 300</td>
</tr>
<tr>
<td></td>
<td>IN-1PU</td>
<td>0.0</td>
<td>1 buffalo</td>
<td>Hand</td>
<td>1 200</td>
</tr>
<tr>
<td></td>
<td>IN-9PU</td>
<td>6.4</td>
<td>3 buffaloes, 6 crossbreed cows</td>
<td>Hand</td>
<td>2 900</td>
</tr>
<tr>
<td>India (Karnataka)</td>
<td>IN2-KA</td>
<td>0.8</td>
<td>2 crossbreed cows</td>
<td>Hand</td>
<td>3 300</td>
</tr>
<tr>
<td></td>
<td>IN-4KA</td>
<td>1.6</td>
<td>4 crossbreed cows</td>
<td>Hand</td>
<td>3 300</td>
</tr>
<tr>
<td>Pakistan</td>
<td>PK-1</td>
<td>0.0</td>
<td>1 buffalo</td>
<td>Hand</td>
<td>1 300</td>
</tr>
<tr>
<td></td>
<td>PK-10</td>
<td>6.0</td>
<td>8 buffaloes, 2 crossbreed cows</td>
<td>Hand</td>
<td>2 400</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>BD-2</td>
<td>0.4</td>
<td>2 cows</td>
<td>Hand</td>
<td>950</td>
</tr>
<tr>
<td></td>
<td>BD-10</td>
<td>1.5</td>
<td>10 cows</td>
<td>Hand</td>
<td>1 300</td>
</tr>
<tr>
<td>Thailand</td>
<td>TH-14</td>
<td>2.1</td>
<td>14 Holstein cows</td>
<td>Machine</td>
<td>3 850</td>
</tr>
<tr>
<td></td>
<td>TH-106</td>
<td>3.0</td>
<td>106 Holstein cows</td>
<td>Machine</td>
<td>4 350</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>VN-2</td>
<td>0.5</td>
<td>2 Holstein cows</td>
<td>Hand</td>
<td>4 100</td>
</tr>
<tr>
<td></td>
<td>VN-4</td>
<td>0.2</td>
<td>4 Holstein cows</td>
<td>Hand</td>
<td>4 000</td>
</tr>
<tr>
<td>China4</td>
<td>CN-3</td>
<td>0.0</td>
<td>3 Holstein cows</td>
<td>Machine</td>
<td>2 600</td>
</tr>
<tr>
<td></td>
<td>CN-12</td>
<td>0.0</td>
<td>12 Holstein cows</td>
<td>Machine</td>
<td>4 400</td>
</tr>
<tr>
<td>Uganda</td>
<td>UG-3</td>
<td>22.3</td>
<td>3 local dairy cows</td>
<td>Hand</td>
<td>460</td>
</tr>
<tr>
<td></td>
<td>UG-13</td>
<td>41.5</td>
<td>13 local dairy cows</td>
<td>Hand</td>
<td>400</td>
</tr>
<tr>
<td>Cameroon</td>
<td>CM-10 peri-urban area</td>
<td>30</td>
<td>10 crossbreed cows</td>
<td>Hand</td>
<td>1 150</td>
</tr>
<tr>
<td></td>
<td>CM-35 rural area</td>
<td>41.5</td>
<td>35 local dairy cows</td>
<td>Hand</td>
<td>500</td>
</tr>
<tr>
<td>Morocco</td>
<td>MA-4</td>
<td>2.0</td>
<td>4 Holstein cows</td>
<td>Hand</td>
<td>2 200</td>
</tr>
<tr>
<td></td>
<td>MA-12</td>
<td>13.0</td>
<td>12 Holstein cows</td>
<td>Hand</td>
<td>2 200</td>
</tr>
<tr>
<td>Peru</td>
<td>PE-6</td>
<td>7.6</td>
<td>6 dairy cows</td>
<td>Hand</td>
<td>2 150</td>
</tr>
<tr>
<td></td>
<td>PE-15</td>
<td>7.3</td>
<td>15 dairy cows</td>
<td>Hand</td>
<td>4 500</td>
</tr>
<tr>
<td>Germany</td>
<td>DE-30</td>
<td>50.0</td>
<td>30 dual-purpose cows</td>
<td>Pipeline machine</td>
<td>6 800</td>
</tr>
<tr>
<td></td>
<td>DE-80</td>
<td>80.0</td>
<td>80 Holstein cows</td>
<td>Herringbone Parlour</td>
<td>7 900</td>
</tr>
<tr>
<td>USA (Wisconsin)</td>
<td>US-80</td>
<td>93.0</td>
<td>80 Holstein cows</td>
<td>Side-by-side parlour</td>
<td>8 700</td>
</tr>
<tr>
<td></td>
<td>US-350</td>
<td>275.0</td>
<td>350 Holstein cows</td>
<td>Side-by-side Parlour</td>
<td>10 500</td>
</tr>
<tr>
<td>New Zealand5</td>
<td>NZ-282</td>
<td>96.0</td>
<td>282 Holstein/Jersey crossbreed cows</td>
<td>Parlour</td>
<td>4 300</td>
</tr>
<tr>
<td></td>
<td>NZ-1042</td>
<td>299.0</td>
<td>1,042 Holstein/Jersey crossbreed cows</td>
<td>Rotary</td>
<td>5 100</td>
</tr>
</tbody>
</table>

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1 Example IN-2OR = Indian 2-cow farm in Orissa (see Annex 5)
2 Average number of dairy cows (dry and lactating) per annum.
3 Milk yield per cow and year (ECM).
4 Both farms are located in a ‘dairy garden’, where an investor has set up the infrastructure and provided a central milking facility.
5 On both farm types, the cows are kept outside all year round and are milked in milking parlours or on rotary milking systems.

**Herd sizes and milk yields**

Herd sizes on typical farms included in the study range from one buffalo/cow in Pakistan to 1 042 cows in New Zealand. Milk yields, similar to herd sizes, are extremely variable and range from 395 kg/cow in Uganda to 10 500 kg/cow on the larger farm type in the USA. These simple figures clearly demonstrate the enormous diversity that exists among milk production systems around the world.
4.2 Overview of selected dairy farm types
4.3 Overview of the whole farm

Returns structure of the whole farm

Most of the farm types included in the assessment were specialized dairy farms obtaining more than 60 percent of their returns from dairy activities. Non-specialized dairy farms (with less than 60 percent of their returns from dairying) were observed in Bangladesh (Sirajganj), India (Orissa and Punjab), Pakistan (Layyah) and Uganda (Kayunga), mainly because dairying is a supplementary occupation in mixed farming systems.

Many dairy farms also have crop enterprises that produce mainly cash crops. Other typical non-dairy activities include sheep- or goat-raising (PK-1, BD-2, UG-13, PE-6); poultry production (IN-4KA, PK, BD-2, TH-14, UG-3); pig-raising (UG); fish-farming (BD-10); contract labour/custom work (DE-30S, US-80WI); and forestry (DE-30S). Off-farm activities are very common on small farms in Bangladesh, India, Morocco, Pakistan, Thailand, Viet Nam and Uganda. The DE-30S farm obtained additional income from renting out houses.

Capital structure of the whole farm

The chart shows the share of liabilities on total assets, which range from 0 percent to 65 percent. These liabilities can be grouped into four share categories:

- **Very high – more than 50 percent:** CN-3.
- **Medium – 30 to 50 percent:** US-350WI and New Zealand farm types.
- **Low – 0 to 30 percent:** Half of the farms fall into this range.
- **No liabilities:** While individual farms with no liabilities were found in all developing countries (except China), all farms in industrialized countries have some liabilities.

These differences can be explained by the following:

- **Production systems** require different capital inputs.
- **Growth under a quota regime** calls for large investments in quota.
- **Farm history:** Farmers who have recently invested in setting up or expanding a farm need credit.
- **Land ownership:** Farmers who historically own land or have expanded their farms by renting more land have chances of investing only in livestock, machinery and buildings without taking on high debts. In New Zealand, where farms grow by means of land purchases, debt levels are relatively high and restrict growth.
- **Access to capital markets:** Liabilities are low in Asia and Africa because it is difficult to obtain capital for farming activities.

Profit margins

Profit margins range from -36 percent to +70 percent. As a general rule, margins are high (more than 25 percent) on small family farms because they are run without hired labour and have limited liabilities.

Explanation of variables

- **Farm codes:** Example DE-30S= German 30-cow farm in the south (for details see Annex 5).
- **Returns:** All cash receipts plus value of products consumed by household plus change in inventory (e.g. livestock).
- **Dairy returns:** Milk sales, cull cows, heifers, calves, direct payments, and also marketable milk consumed on-farm.
- **Cash crops:** Sales of surplus crops such as grain, soybean, etc. (plus related crop payments).
- **Other returns:** Beef fattening, forestry, poultry, etc.
- **Liabilities:** Total year-end liabilities (leasing and operating loans not included).
- **Equity:** Total assets (book value of machinery, buildings, market values of livestock, land and quota) – liabilities.
- **Farm income:** Total returns minus costs from the profit and loss (P&L) account (cash costs + depreciation + balance of input inventory).
- **Profit margin (share of farm income on total returns):** Farm income divided by farm returns. This figure provides an idea of how vulnerable a farm may be to changes in farm costs or returns. If the margin is small, the farm has no risk buffer.
4.3 Overview of the whole farm

Return structure of the whole farm

Capital structure of the whole farm

Profit margin of the whole farm (share of farm income on total returns)
4.4 Farm income, profits and returns to labour

Farm income

The ‘farm income’ indicator describes a farm’s income based on the profit and loss (P&L) account. On family farms, this income provides the basis for covering family livelihoods and asset or capital growth. Salaries are deducted for farms that have hired labour. Farm income ranges from US$3/100 kg of milk to US$38/100 kg of milk. Smaller farms tend to have higher farm incomes per 100 kg of milk because of the higher proportion of family labour, which is not deducted. In Cameroone and Viet Nam, however, larger farms with hired labour generate higher farm incomes than the smaller farms, mainly because the former obtain higher output prices (Viet Nam) or have low wage costs for hired labour (several larger farms in Cameroon share a herdsman).

Entrepreneur profit

The ‘entrepreneur profit’ indicator shows whether farms cover their full economic costs. If the indicator is positive, all costs shown in the P&L account can be covered and family-owned production factors (labour, land, capital and quota) can be paid at market price (opportunity cost). In this case, farming systems are financially sustainable. Entrepreneur profits range from -US$15/100 kg of milk to +US$34/100 kg of milk; some 73 percent of the farms make a positive entrepreneur profit. Negative profits (losses) are found on the smaller farm types in Morocco, New Zealand, Pakistan and Peru, and on both farm types in China and Germany. In nearly all countries except Thailand and Uganda, the larger farm types earn greater profits per 100 kg of milk than the smaller ones. As mentioned earlier, the main reasons why the smaller farm types in Thailand and Uganda make higher profits predominantly relate to their higher non-milk returns due to high prices for cattle (and beef).

Returns to labour

The ‘returns to labour’ indicator shows the ‘value’ created (per hour) by a farm labourer and indicates the potential wage that can be paid. A comparison of returns to labour with the wage rate in the region concerned shows whether a farm can compete on the local labour market and cover its full economic costs. Farms unable to compete with wage levels in their regions may stay in business until a generation change takes place or as long as farmers are satisfied with the ‘wages’ they obtain for their work. For reasons of simplification, three general levels can be defined:

- Less than US$1/hour: All farm types in the developing countries, except the larger farm types in Cameroone and Peru, have returns to labour of less than US$1.00/hour to put back into the dairy farm enterprise. This group represents 73 percent of the farms analysed here.
- More than US$10/hour: The larger farm types in Germany and New Zealand and both farm types in the USA.

Competitiveness on the labour market

Farms are competitive on the local labour market if their returns to labour input exceed wage levels in their regions. In Asia, the large farm types and both small and large farm types in Thailand and Viet Nam have competitive returns to labour but neither of the Chinese farms can compete on the local labour market, mainly due to the relatively high wage levels in the region. Diversity of local wage levels is large in Africa, as are returns to labour. Returns to labour in dairy farming are locally competitive only in Cameroone due to the grazing practices that keep labour costs low and because of the relatively high amount of beef/livestock sales that make a huge impact on dairy profitability. In Peru, the larger peri-urban farm type generates competitive returns to labour in relation to the local wage rate.

In the industrialized countries, the larger farm types generate higher returns to labour than the smaller ones and are thus more competitive on the local labour market. The most profitable farms were found in the USA, followed by the large farm type in New Zealand. Both farm types in Germany would need to undergo major restructuring if they are to generate locally competitive returns to labour. The overall difference between the highest- and lowest-performing dairy farms in terms of returns to labour input, is in the order of US$32.6/hour (US-350WI with US$33/hour and IN-9PU with US$0.4/hour).

Explanation of variables

Farm codes: Example DE-30S = German 30-cow farm in the south (details see Annex 5).
Returns of the dairy enterprise: All dairy enterprise returns (as described in Annex 8).
Farm income: Returns minus costs in dairy enterprise’s P&L account.
Entrepreneur’s profit: Total returns minus full economic costs (costs from P&L account + opportunity costs) of dairy enterprise.
Returns to labour: Entrepreneur’s profit plus labour costs divided by total labour input.
Average farm wages: This figure represents the gross salary + social fees (insurance, taxes, etc.) that the employer is obliged to cover.
Calculation: Total labour costs (wages paid plus opportunity costs) divided by the total hours worked. For this calculation, an estimate has been made of the number of hours worked by family members and employees.
4.4 Farm income, profits and returns to labour

**Returns and profits**

US$100 kg milk (ECM)

- Returns of the dairy enterprise
- Farm income
- Entrepreneur’s profit

**Return to labour**

US$/hour

- Return to labour
- Average wages on the farm
4.5 Asset structure and returns on investments

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### Capital assets/investment per 100 kg milk

An analysis of asset structure and returns on investment provides indications of where best to invest profitably in dairy farming. This variable details the level of investments per 100 kg of milk required by the respective farm type. The return on investment is shown in order to rank the farming systems based on how efficiently they use their capital to generate profit.

With regard to assets, the capital input per 100 kg of milk ranges from US$20 to US$370 for the farm types assessed and may be grouped as follows:

- **More than US$200:** Germany (DE-30S), India (IN-9PU and IN-2KA), Morocco (MA-12) and Peru. The main investment factors are land prices, livestock value, machinery and quota owned.

- **Between US$100 and 200:** Some Asian farmers who own land and have cross- or purebred dairy animals and small dairy herds fall into this group. Purebred dairy cows and quota bring assets up to this level in MA-4 and DE-80N, respectively.

- **Less than US$100:** About half the farms fall into this category, mainly because they own little or no land. Most Asian farms allocate little, if any, land to dairying itself but rely heavily on agricultural residues and purchased inputs. In Viet Nam, farmers are not allowed to own land; in China, farmers rent barn facilities, purchase all farm inputs and practise fully-confined dairying. For grazing, most African farmers depend on public land for which they pay a small fee. In the USA, large herd sizes and heavy purchases of feedstuff (leading to less land requirements) greatly reduce the farmers’ asset base per 100 kg milk.

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### Asset composition

- **Quota:** High quota shares were found on the German farms.

- **Land:** Land values (sometimes reaching as much as 90 percent) dominate asset composition in Oceania and Western Europe, and in dairy production systems in Bangladesh, India, Pakistan, Peru and Thailand operating on own land.

- **Livestock:** Livestock values form the major asset in farms operating with little or no owned land, such as IN-1PU, PK-1 and farms in China, Uganda, and Viet Nam.

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### ‘Other’ assets

For most farms these consist of circulating capital, the share of which is too small to appear on the graph. In New Zealand, ‘other assets’ are shares in a dairy cooperative and account for 15-25 percent of farm assets.

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### Returns on investments

Returns on investments (ROIs) range between -18 and +40 percent. Most farms fall into the -3 to +5 percent range. High ROIs (more than 10 percent) were found in Cameroon (CM-35), India (IN-6OR), Viet Nam (VN-4) and the USA (US-350WI). It is important to note that in eight of the 13 countries, that is China, Germany, Morocco, New Zealand, Pakistan, Peru, Thailand and Uganda, neither of the two farm types evaluated had ROIs above 5 percent.

Inflation rates in all countries range between 1 percent and 9 percent (source: International Monetary Fund (IMF)). The highest rates, 7 to 9 percent, were observed in Bangladesh, Pakistan and Uganda.

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### Explanation of variables

- **Farm codes:** Example DE-30S = German 30-cow farm in the south (details see Annex 5).
- **Calculation of farm assets:** Land, livestock, cooperative shares and quota at market price, machinery and buildings by book values.
- **ROI:** (Entrepreneur’s profit + estimated interest (on non-land, non-quota assets) + interest on quota + opportunity cost of land (by land rents))/all farm assets minus inflation rate for the year 2005. Changes in asset values (land, livestock, etc.) have not (yet) been included.
- **Inflation rate:** IMF World Economic Outlook 2004/2005/2006, gross domestic product deflator for developed countries, CPI (consumer Price Index) for the other countries.
4.5 Asset structure and returns on investments
4.6 Producer milk prices and non-milk returns

Milk prices – overview

Milk prices per 100 kg of ECM range from US$12 to US$36 and may be grouped into the following categories:

- **Less than US$20/100 kg:** Observed in Pakistan and Uganda for farms far from urban centres and in areas with poor infrastructure. The lowest price was observed in Ugandan farms at US$12/100 kg of ECM
- **Between US$20 to 30/100 kg:** The majority of the farms studied receive milk prices that fall into this category. Farmers in India, New Zealand and Viet Nam are at the lower end of the scale, whereas farmers in Bangladesh and Thailand obtain prices at the higher end. In Peru, one farm is located in a peri-urban area and the other in a rural area, which explains the very significant price differences within the country.
- **More than US$30/100 kg:** Farmers in Cameroon, Germany, Morocco and the USA all obtain milk prices of around US$35/100 kg of ECM.

A dual milk price structure appears to exist at the global level, with most farms obtaining prices around the world market level. (The ‘world’ market price for milk can be calculated by taking the average world market price for butter and SMP, multiplying it by technical coefficients and subtracting processing costs. In 2006, this price stood at around US$26.5/100 kg.) The Moroccan and Cameroonian farms analysed receive prices above those of the world market, similar to those received by their German and US American counterparts. In Morocco, the key driver is the tariff protection, which is similar to that in the EU. Cameroon appears to represent a special supply/demand situation with regard to fresh milk.

Milk prices – explanations/details

- **Bangladesh/Thailand:** These countries are large net importers of milk, and have restricted imports of dairy products by means of tariffs (Bangladesh, 35 percent) and import quotas (Thailand).
- **Pakistan:** Both farms are located in rural areas in the southern part of Punjab, which is a new dairy region far away from large consumer markets.
- **China (north):** These farms are part of a cooperative. Milk prices are dictated by the investor who set up the farm infrastructure.
- **Africa:** Milk prices in Cameroon and Morocco are the highest, while those in Uganda are the lowest.

**Peru:** The larger farm received higher prices because it is part of a government-sponsored school milk programme.

**New Zealand:** The prices received by farmers were a combination of advance payments for the 2004/2005 season and deferred payments from the previous one.

Non-milk returns

In addition to the income received from milk sales, dairy farms also obtain revenue by means of direct payments, sales of livestock, and sales of manure as fertilizer and household fuel for domestic use (South Asia). These non-milk returns range from US$1.6 to US$35/100 kg of ECM and contribute from 6 to 51 percent of total farm returns. High shares were observed in China (CN-3), Morocco (both farm types) and Uganda (UG-3), mainly as a result of high prices for beef and heifers (China and Morocco) and very low milk yields (Uganda).

Direct farm support

Among the farms studied, direct payments are found only in Germany and the USA, where the level of support is US$6.5 to 11.0 and US$0.7/100 kg of ECM, respectively. No direct support payments are received by farmers in Africa, Asia, Latin America and Oceania.

- **Germany:** Farms in southern Germany were found to receive higher direct payments. These farms are located in less favourable areas and receive payments for extensive use of grassland or for farming in hilly areas.
- **USA:** Dairy farmers cultivating feed grains or soybean receive various subsidies in the form of fixed and deficiency payments. For maize, these payments represented about 40 percent of the market price in 2005.

Support for investments in dairy farming

In many countries, the government and/or non-governmental institutions provide support to the dairy sector by means of investment aid or subsidized interest rates. Although many specific support programmes for dairy development have been set up in both the industrialized and developing countries, there also appears to be a large number of ‘not-so-evident’ programmes in most countries studied. Thus, direct payments constitute only a small part of measures in support of dairy farming.

**Explanation of variables**

- **Farm codes:** Example DE-30S = German 30-cow farm in the south (details see Annex 5). **Milk prices:** Average milk prices adjusted to ECM, excluding value-added tax (VAT).
- **Cattle returns:** Returns from sales of cull cows, calves and surplus heifers +/- livestock inventory changes. **Direct payments:** All government payments including coupled and decoupled payments. **VAT balance:** Farms that do not balance the VAT with the tax department have either a positive or a negative balance depending on if the VAT on farm returns is more or less than that on farm costs respectively.
4.6 Producer milk prices and non-milk returns

![Graph showing milk prices and non-milk returns for various farm types.](image-url)
4.7 Costs of milk production only; milk prices

Costs of milk production only, 2005 – overview

The variable ‘cost of milk production only’ includes all costs incurred by the dairy enterprise. However, the non-milk returns (e.g. returns from the sale of calves, heifers and cull cows) have been deducted from these to allow for a ‘fair’ comparison of milk production costs across different milk production systems. Three categories of milk production costs, expressed in United States dollars per 100 kg of ECM, were identified with regard to the countries and farm types analysed:

- **Less than US$15/100 kg**: The larger farm types in Cameroon, Pakistan and Uganda.
- **Between US$15 and 30/100 kg**: Farms in Bangladesh, New Zealand and the USA, most farms in India, the smaller farm type in Pakistan, and the larger ones in China and Peru.
- **More than US$30/100 kg**: Farms in Germany, Morocco and the small farm types in China and Peru.

Costs of milk production only, 2005 – explanations/details

**Cameroon**: The costs incurred by the small farm type (with Holstein Friesian cows) are comparatively higher owing to expensive feed and low productivity. The large farm type, on the other hand, is a cow-calf operation where some of the cows are milked. A large part of the milk is retained on-farm for feeding calves.

**Peru**: Costs are relatively higher than those in the Asian countries owing to (relatively) higher wage levels.

**India (Orissa)**: Farm IN-2OR-B shows the highest degree of complexity of all farm types analysed (very low milk yield, high share of non-cash transactions, wide range of outputs from the dairy enterprise). It was very difficult to estimate the opportunity costs of family labour for this farm, and they may have been overestimated due to the method used (the method has subsequently been modified to ensure more accurate analysis of labour inputs in subsistence farming).

In almost all countries (with the exception of Thailand and Uganda), the cost of milk production only was lower in the larger farm types compared to their smaller national counterpart, suggesting that further structural changes in the dairy sector will take place in all regions in future.

Most cost-competitive milk producers by region

Based on the price in United States dollars per 100 kg of milk, the lowest-cost producing dairy farming systems in the various regions were:

**Africa** (Cameroon, Morocco, Uganda)
- 3-cow herd in Uganda* US$10

**Southeast Asia** (China, Thailand, Viet Nam)
- 4-cow herd in Viet Nam US$13

**South Asia** (Bangladesh, India, Pakistan)
- 10-cow herd in Pakistan US$14

**Oceania** (New Zealand)
- 1 042-cow herd US$21

**Latin America** (Peru)
- 15-cow herd US$23

**North America** (USA)
- 350-cow herd US$26

**Western Europe** (Germany)
- 80-cow herd US$38

It should be noted that for the last four regions, the table is based on two typical farms from one country only.

Explanation of variables

Farm codes: Example DE-30S = German 30-cow farm in the south (details see Annex 5).

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

Opportunity costs: Costs for using own production factors within the enterprise (own land and capital, family labour).

Quota costs: Quota rents paid plus opportunity cost of quota owned (3 percent interest on quota value).

Milk price: Average milk prices adjusted to ECM, excluding VAT.

* Although imputed costs of milk production were lower on CM-35, milk is a by-product of cattle-raising for beef production, and thus this farm is not considered to be the most competitive.
4.7 Costs of milk production only; milk prices

In order to estimate the cost of milk production in a way that allows direct comparison with the milk price, the non-milk returns (cattle returns and direct payments) have been subtracted from the total costs of the dairy enterprise. The figure shows the details of the calculation.
4.8 Total milk production costs and returns to the dairy enterprise

Introduction

The previous section provided a simplified picture of the cost of milk production only, whereas this section considers the total costs of the dairy enterprise per 100 kg of milk and relates them to three different return items: milk returns; returns from sales of cull cows, calves and heifers; and other dairy enterprise returns, e.g. from sales of manure and direct payments. To provide an overview of farm dependence on the various return items, the graph on the next page shows the following: (i) milk price only; (ii) milk price plus returns from sales of cull cows, etc., plus other returns; and (iii) the previous two, plus direct payments received. This overview facilitates an understanding of how different farm types might be affected by variations in milk and non-milk returns.

Vulnerability to reductions in cattle and beef prices

Some farms would be badly affected by a sharp drop in cattle and beef prices:

- Moroccan farms that receive US$21 to 35/100 kg ECM (Energy Corrected Milk) from cattle sales.
- Cameroonian farms that obtain US$11 to 13/100 kg ECM from cattle sales.
- Farms in China, Peru and Viet Nam that receive about US$11/100 kg ECM.
- India IN-2OR-B, which receives US$11/100 kg ECM. However, this farm does not really depend on beef prices in the strict sense, as most of its non-milk returns are derived from sales of lactating buffaloes. It would appear, therefore, that this farm type is highly dependent on prices for live animals.

Vulnerability to reductions in direct payments

German dairy farm incomes would decrease by 40 to 50 percent if farmers did not receive direct payments. This is because instead of incomes of US$18 or US$12 per 100 kg of ECM, farmers would obtain only US$10 or US$6 per 100 kg of ECM.

Resilience to reductions in non-milk returns

Some farms would be affected only slightly by a sharp drop in non-milk returns, namely, the farms in New Zealand and in the Indian state of Karnataka, because beef and cattle prices are low and farmers do not receive any direct payments. Furthermore, profit margins are sufficiently high on the majority of the smaller family farm types analysed in this chapter to ensure that there would be no losses in the P&L account in the event of a large reduction in non-milk returns.

Comparison of milk production cost calculations

The calculations of production costs for 100 kg ECM given in this section and in Section 4.8 differ, especially for farms with high non-milk returns. The method employed in Section 4.7, referred to as ‘cost of milk production only’, shows whether the milk price received by the farmer covers the net cost (i.e. the full economic costs minus the non-milk returns) of producing it. The method used in this section provides information on the full economic costs of the dairy enterprise. As set out in the following table, the cost difference between German and USA dairy farms based on the latter method is US$18/100 kg ECM compared with US$12/100 kg ECM using the first method. The conclusion reached with both methods is the same: at a full economic cost of US$50/100 kg of milk, production on the farm in Germany costs US$18 more per 100 kg of milk than in the USA and, after allowing for non-milk returns (US$12 in Germany and US$8 in the USA), costs only US$8 more.

<table>
<thead>
<tr>
<th>Cost of ‘milk production only’</th>
<th>Non-milk returns</th>
<th>‘Full cost’ of the dairy enterprise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm: DE-80N</td>
<td>38</td>
<td>12</td>
</tr>
<tr>
<td>Farm: US-80WI</td>
<td>30</td>
<td>8</td>
</tr>
<tr>
<td>Difference</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

Explanation of variables

Farm codes: Example: DE-30S = German 30-cow farm in the south (details see Annex 5).
Cash costs: Purchased feed, fertilizer, seed, fuel, maintenance, land rents, interest on liabilities, wages paid, veterinary services plus medicine, water, insurance, accounting, etc. (excluding VAT).
Depreciation: Annual decrease of the purchase price of buildings, machinery based on lifespan (excluding VAT).
Opportunity costs: Costs for using own production factors (land owned, family labour input, equity including quota).
Milk price: Average milk prices adjusted to ECM, excluding VAT. These would be the returns in the event all direct payments and all beef returns were nil.
Milk price plus non-milk returns without direct payments: Milk price + cull cow, calves, heifer returns + changes in livestock inventory + other returns, such as sales of manure. These would be the returns in the event no direct payments were made.
Milk price plus all non-milk returns, including direct payments: This represents the current return structure of the farms.
4.8 Total milk production costs and returns to the dairy enterprise

**Total costs and returns of the dairy enterprise**

This graph compares the total costs with different return levels of the dairy enterprise.

**Method**

This graph compares the total costs with different return levels of the dairy enterprise.
4.9 Cost component: labour

**Labour costs/100 kg milk**

Labour is one of the main costs incurred in dairy farming. To obtain a better picture of the structure of labour costs, the opportunity costs and wages are shown separately in the graph. Total labour costs range from US$2 to US$25/100 kg of milk. Different levels can be discerned:

- **High (more than US$10/100 kg milk):** The farms in China, Germany, and the smaller farm types in Bangladesh, Orissa (India), Morocco and Pakistan.
- **Intermediate (US$5 to 10/100 kg milk):** Both farm types in Uganda, Cameroon and USA; the small farm types in Punjab (India) and Viet Nam; and the larger farm types in Bangladesh, China and Morocco.
- **Low (less than US$5/100 kg milk):** Both (small and large) farm types in Karnataka (India), New Zealand and Thailand, and the large farms in Orissa and Punjab (India), Pakistan and Viet Nam.

Labour cost differences may be explained by differences in wages and/or differences in labour productivity. For example, labour costs per 100 kg of milk on the large New Zealand farm type (NZ-1042, US$4/100 kg) amount to 30 percent of those on the small German dairy farm type (DE-80N, US$13/100 kg). The New Zealand farm pays only 60 percent of the German wages (US$10.81/hour vs. US$18.19/hour) and produces 2.3 times the amount of milk per hour of farm labour (321 kg/hour vs. 140 kg/hour).

**Regional wages for farm labour**

Milk production is labour-intensive and farm wages, which vary considerably across countries/regions, are important determinants of international competitiveness. Highest wages were observed in the industrialized nations, ranging from a low of US$10/hour to a high of US$18/hour for farms in New Zealand and Germany, respectively. In Latin America, wages orbit around US$1/hour, while on the African and Asian farms, wages vary from US$0.05/hour to US$0.60/hour. In general, three wage levels for farm labour can be defined:

- **High (more than US$10/hour):** Farms in all industrialized countries reviewed.
- **Low (between US$0.5 and 1.5/hour):** Observed in China, Morocco and Peru.
- **Very low (less than US$0.5/hour):** Found on all remaining farms in Africa, South Asia and Southeast Asia.

**Labour productivity**

Apart from wage levels, labour productivity also determines the level of a farm’s competitiveness and may be influenced by the farmer and the production system adopted. In line with regional wages for farm labour, three labour productivity levels, expressed in kilograms of milk per hour worked, were observed:

- **High (more than 50 kg/hour):** Found on all farms in industrialized countries (Germany, New Zealand and the USA). On these farms, labour is used very efficiently thanks to labour-saving mechanization and economies of scale. However, even within dairy farms in industrialized countries, large differences in labour productivity exist, ranging from 70 kg/hour on the larger German farm type to as much as 321 kg/hour on the large New Zealand farm. With year-round grazing, labour efficiency in New Zealand is determined by economies of scale, investments in labour-saving devices and a system whereby the cows mainly graze on their own and distribute their effluent on the grazing land.
- **Low (10 to 50 kg/hour):** This small group consists of both farms in Thailand and the smaller farm type in Germany. Variations within the group are determined mainly by milk yields, wage levels and management approach.
- **Very low (less than 10 kg/hour):** Key factors explaining low labour productivity in Africa, Asia (except for Thailand) and Peru are very low wages and limited access to capital, which result in labour-intensive and capital-extensive production systems with low investments in labour productivity-enhancing equipment.

**Explanation of variables**

- **Farm codes:** Example DE-30S = German 30-cow farm in the south (details see Annex 5).
- **Labour input:** It is very difficult to estimate the number of hours worked and the cost, especially on family farms. For hired labour, the hours worked are estimated, whereas with regard to family labour the number of hours are based on the time a skilled worker would need to run a farm along the same lines as a family farm.
- **Labour costs:** Paid wages and opportunity costs for own labour.
- **Average wage on the farm:** The gross salary + social fees (insurance, taxes, etc.) the employer is obliged to cover. Calculation: Total labour costs (wages paid plus opportunity costs) divided by the total hours worked. For this calculation, an estimate was made of the number of hours worked by the employees and family members.
- **Labour productivity:** Kilograms of ECM produced per hour of labour input on the farm.
4.9 Cost component: labour

- Labour costs
  - US$/100 kg milk (ECM)
  - Wages paid
  - Calc. costs for family labour

- Average wages on the farm
  - US$/hour

- Labour productivity
  - kg milk (ECM)/hour

Farm types
4.10 Cost component: land

**Land costs/100 kg milk**

Land costs contribute between 2 percent and 30 percent of the total costs of dairy farms that rent or own land, and range from US$0.05 to US$8.1/100 kg of milk. In many instances land costs are extremely variable within countries, owing to differences in land rental values (e.g. significantly higher in peri-urban than rural areas), land quality and the amount of land used for dairy production.

- **High land costs (more than US$5/100 kg of milk):** High land costs were observed in Morocco (MA-12), New Zealand (NZ-282), Peru (PE-6) and Viet Nam (VN-2).
- **Intermediate land costs (US$2-5/100 kg of milk):** The majority of farms had land costs falling into this range and representative cases were found in Bangladesh, Cameroon, Germany, India (Karnataka, Orissa, Punjab), Morocco, New Zealand, Peru, Uganda, and the USA.
- **Low land costs (less than US$2/100 kg of milk):** Low land costs were estimated for some farm types in Bangladesh, Cameroon, India (Karnataka, Orissa, Punjab), Pakistan, Thailand, the USA and Viet Nam.

**Land rental prices**

In the countries reviewed, land rents range from US$9 to US$745 per hectare:

- **More than US$300/ha:** All farms in Morocco, New Zealand and Viet Nam; and large farms in Germany and India (Punjab).
- **US$100 to 300/ha:** All farms in Bangladesh, India (Orissa and Karnataka), Pakistan, Peru and the USA; and the small farm type in Germany.
- **Less than US$100/ha:** All farm types in Cameroon and Thailand.

The level of land rental prices in Viet Nam can be explained by high population density in the areas where they were located (in the vicinity of Hanoi) and the large demand for urban/peri-urban land.

Land rents are affected by various factors. As a general rule, the following factors have a bearing on land rents:

- Soil quality/crop yield and crop prices.
- Livestock density in the area.
- Competition for land.
- Environmental regulations, i.e. maximum stocking rates.
- Acreage payments and other payment schemes.
- Urbanization and competition from non-agricultural interests.
- Quantity of land available on rental markets.
- Social relations between land owners and tenant farmers.

**Land productivity**

Land productivity ranges from 1 000 to 154 000 kg of milk/ha. These differences are mainly a result of the various types of milk production system adopted, which differ from country to country and even within countries. For instance, farms in India (IN-6OR and IN-4KA), Thailand (TH-106) and Viet Nam (VN-4) have a very high milk output per area of farmland, which is mainly determined by large purchases of feed and fodder, and intensive use of concentrates.

**Explanation of variables**

- **Farm codes:** Example DE-30S = German 30-cow farm in the south (details see Annex 5).
- **Land costs:** Land rents and opportunity costs for own land (calculated rent) of the dairy enterprise.
- **Level of land rents/ha:** Land rents + calculated land rents for own land divided by the total land of the farm.
- **Land productivity:** Kilograms of ECM produced per ha of land in one year.
4.10 Cost component: land

- **Land costs**
  - US$/100 kg milk (ECM)
  - Land rents paid
  - Land rents calculated for land owned

- **Level of land rents**
  - US$/ha

- **Land productivity**
  - 1,000 kg milk (ECM)/ha
4.11 Cost component: capital (excluding land and quota)

- **Capital costs/100 kg milk**

It is often difficult to estimate capital costs incurred in dairy farming because any cost comparison is challenged by differences in depreciation schemes, land valuation, levels of inflation, capital structure and interest rates. A method that yields sufficiently accurate results for most cases is to calculate interest on liabilities at 6 percent and for own capital at 3 percent. For some countries, among them China, this method slightly overestimates capital costs; for others, including India and Pakistan, the method produces slight underestimates.

Capital costs contribute approximately 3 to 29 percent of the total costs of the dairy farms studied, and thereby explain more or less as much as land costs on total cost differences. Capital costs range from US$0.8 to US$5.7/100 kg of milk, but for most farms they are in the order of US$1 to 2/100 kg of milk.

- **High capital costs** (more than US$3/100 kg) were observed for all Moroccan, New Zealand and Ugandan dairy farm types and for the small farm types in Cameroon, Germany and India.
- **Low capital costs** (less than US$1/100 kg of milk) were observed for the larger farm types in China and in Pakistan.

The considerable capital costs in New Zealand can be explained by high land prices and cost of shares in the cooperatives.

The smaller dairy farm in Germany (DE-30S) has high capital costs due to large investments in buildings and machinery (two and four times, respectively, that of DE-80N for each 100 kg of ECM produced). The main determinant of the high capital costs in Uganda and Morocco is low capital productivity.

- **Capital input/cow**

Capital costs per 100 kg of milk are a cost component of dairy production but do not provide information on the capital intensity of a dairy farm because, to a large extent, they are determined by the level of farm liabilities. The indicator ‘capital input/cow’, which only takes account of the capital embedded in the dairy herd, buildings and machinery and cooperative shares, gives a better sense of the ‘capital-intensity’ of a dairy farm. The different levels observed on the farms under study were as follows:

- **High (more than US$2 500/cow):** All farms in Germany, Morocco, New Zealand and the USA.
- **Intermediate (US$1 000 to 2 500/cow):** All farm types in Thailand and Viet Nam; the large farm type in Peru and the small one in Cameroon.
- **Low (less than US$1 000 US$/cow):** All farm types in Bangladesh, China, India, Pakistan and Uganda; the large farm type in Cameroon and the small one in Peru.

**Explanation of variables**

*Farm codes:* Example DE-30S = German 30-cow farm in the south (details see Annex 5).

*Capital costs:* Interest on liabilities (6 percent) and opportunity costs for own capital (3 percent). This is an estimate of the real interest rate for the international capital market.

*Liabilities:* Figures from the dairy enterprise’s balance sheet. In New Zealand, liabilities exceed the sum of non-land and non-quota assets. In this case, the surplus is not deducted because it is already covered by the other calculations. Example: land costs are calculated on the basis of the rental price and not as interest on the land value.

*Capital input per cow:* Total capital input, except land and quota/number of cows. Values for buildings, machinery, livestock and other operating capital (estimated as 10 percent of variable costs of a crop and dairy enterprise). Land is not included, as land cost is calculated on the basis of the rental price. Quota values are not included here.

*Capital productivity:* Kilograms of ECM produced divided by capital input (except land and quota).
4.11 Cost component: capital (excluding land and quota)

- **Capital costs**
  
  US$/100 kg milk (ECM)

- **Capital input per cow (land and quota value not included)**
  
  1,000 US$/cow

- **Capital productivity per asset (land and quota value not included)**
  
  kg milk (ECM)/1,000 US$