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High-tech and low cost farming: What is the future?

By: Cees Jan Hollander (expert cattle nutrition) Ceesjan.Hollander@wur.nl,
Michel de Haan (project-leader low cost farm) and
Sjoerd Bokma (project-leader high-tech farm)

[The Animal Sciences Group of Wageningen University & Research Center]

Introduction

Dutch dairy farmers' incomes were under pressure in the 1990s. From 1989 to 1997 the family income on an average farm declined steadily, while expenses rose slightly. In the 1996/1997 financial year expenses exceeded revenue – an alarming development that is largely attributable to fluctuations in agricultural prices. Although the costs of labour, land and buildings have increased substantially in recent years, revenue from milk and beef have lagged behind.
As a result of these developments is was concluded that in order to maintain a family income from dairying only, the productivity per working hour and/or per hectare had to increase. This can either be done by reducing costs at the same farm size of by enlarging the farm (in terms of milk production per laborer). The low cost farm and the high-tech farm are the two types of dairy farms of the Animal Sciences Group reflecting these two strategies. Besides these two strategies other strategies are available to practical farmers (like organic farming, production of special products, emigration, shut-down), but these will not be addressed here. The low cost farm was established in 1997, while the high-tech farm started in 1998. Both farms were established in order to study the farming system; main objective for both farms is to control the costs and realise a cost price for milk of € 0,34 or less per kg milk.

High-tech farm

The high-tech farm has a milk quota of 800.000 kg, which is considered to be relatively large for Dutch circumstances. To lower the cost price as many laborious jobs as possible have been automated. The farm is managed by one person in a 50 hours work week. The 80 milking cows are milked by 1 one-box automatic milking system. Feeding is done with a automatic individual feeding system. With this system cows can be fed the ration they need at al time. The aim is to produce as much milk as possible per cow and per laborer. The management strategy is to pay a lot of attention to the animals (animal health, fertility, welfare). As the animals are kept indoors all year round much attention is given to the indoor climate. The calves are kept in quarantine up to the age of six months. This area can only be entered via a decontamination chamber.

Low cost farm

The low cost farm is also a one person enterprise. It has a milk quota of 450.000 kg, which equaled the Dutch average, and a dairy herd of 60 cows. The strategy is to use cheap alternatives to keep the cost price low. Thanks to compact building and cheap materials the building costs are 30 % lower than those of a regular farm. The milking parlour is a simple set-up without automation. The only machinery available for feeding is a silage cutter with putter. On this farm too the farmer works an average of 50 hours per week. 20 % of the calves born are kept as replacements. The housing for the young animals is very cheap and basic. During summer cows are kept on pasture day and night.

Farm structure

The high tech farm has a milk quota of 800.000 kg per year. The herd size is 80 cows, which means that the aim is to produce 10.000 kg milk per cow per year. There is 35 ha of land (clay soil) available. During the first four years this was divided into 22 ha of grass and 13 ha of maize. From 2002 onwards the land has been divided into 8 blocks of 4.38 ha; of which 5 are used as grass and grass-red clover (grass-red clover blocks are managed as such during 2 years, after that they are managed as grass blocks), 2 blocks for maize production and 1 block for winter wheat, harvested as *whole-plant-silage*. Since 2005 the block for winter wheat is also used for maize production.
The low cost farm has a milk quota of 450.000 kg per year. The herd size is 60 cows with 30 dairy cows pure bred Holstein Friesian. The other 30 are from the Montbéliarde breed. This breed was introduced because they are more used to the sober management than the Holstein cows. There is 32 ha (clay soil) of land available: 28,2 ha grass and 3,8 ha maize. We consider this farm to be a "green" farm, because of low fertilizer input and grazing of the dairy cows day and night during grazing season.

Goals
Most important goal for both farms is to reduce costs. The objective for both farms was to obtain a cost price of € 0,34 or less per kg milk. The cost price is calculated by dividing the result of all costs (including costs for capital and all labour, but excluding quota costs) minus all revenues not being milk by the quantity of milk delivered to the dairy company.
Another objective for both farms is to limit labour input to 2600 working hours per year. This on average equals to 50 hours per week, which is considered to be a socially acceptable labour input and is far below the common labour input on dairy farms of comparable size.
According to environmental legislation in the Netherlands from 1998 onwards a mineral balance scheme has been implemented. All mineral input and output from the farm have to be registered and the mineral surpluses for nitrogen and phosphate should not exceed levy-free levels (thresholds). By law the levy-free thresholds were lowered gradually year by year until the final levy-free threshold was reached in 2003 in order to give the farmers the opportunity to adjust their management in the course of time. On the high-tech farm the actual levy-free thresholds per year were used as the objective for the nitrogen and phosphate balance. On the low cost farm however, the final levy-free thresholds have been the objective immediately from the start of the farm. The low cost farm has set a limit to the input of concentrates. The maximum is 16 kg per 100 kg of milk.

Strategy
Although the objectives for both farms may look very similar, the strategies to reach these objectives are very different (as can be seen from the farm structure already). This section lists the most important aspects concerning the strategy of both farms.
On the high-tech farm milking is done by 1 one-box automatic milking system. In order to meet the objectives a high production per cow is required and cows are kept indoors all year round, i.e. *summerfeeding* is performed. To keep the costs for land low, a high milk production per ha is aimed at. Since November 2003 an automatic and individual feeding system is being implemented, not only for concentrates, but also for roughages. By using an automatic milking system, an automatic feeding system and an automatic machine for mixing and dispensing milk to calves many laborious jobs are being automated. Besides, all field work is carried out by contract workers, so that limited machinery is needed. Emphasis is put on cow management and animal health. In this way we want to make efficient use of labour and land and create optimal conditions for cows and the farmer.
The strategy of the low cost farm starts with compact buildings and cheap building materials to reduce costs. The number of young stock is limited to 5 per 10 cows, which reduces the

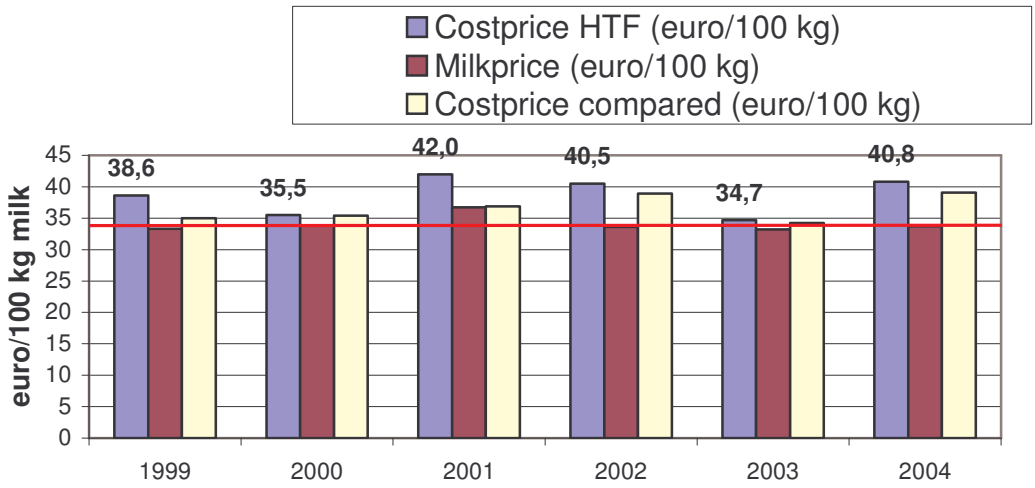
need for housing facilities and reduces the rearing costs. As soon as possible cows go out grazing in the field day and night. This also gives the opportunity to reduce the input of concentrates and reduces the need for contract work (ensiling roughage and application of slurry). White clover is used extensively to reduce the input of nitrogen fertilizer. And as on the high-tech farm also on the low cost farm there is limited machinery, while all the field work is contract work.

Results

Cost price

Figure 1 shows the cost price of the high-tech farm and low cost farm. The results of both farms have been compared with the cost price of a group of commercial practical farms of comparable size. The data for these comparison groups are from the Farms Information Network (BIN) of the Agricultural Economic Research Institute (LEI).

Figuur 1a Results of the costprice of the high-tech farm, the milkprice and the costprice of comparison farm from 1999 – 2004



Figuur 1b Results of the costprice of the low cost farm, the milkprice and the costprice of comparison farm from 1998 – 2004

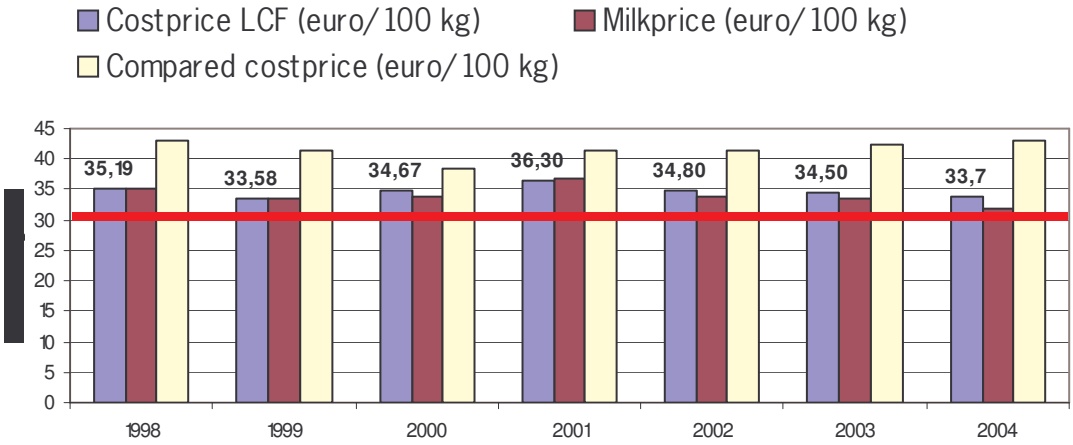


Figure 1a shows that the cost price of milk, produced on the high-tech farm, did not meet the objective of 34 eurocent per kg. The year 2003 was until now the year with the lowest cost price. Furthermore the cost price is higher than the cost price of the comparison group. Main

reason for this is shown in table 1: until 2004 the challenge of producing 800.000 kg of milk per year (with 1 one-box automatic milking system) could not be met. The low milkproduction in 2004 is due to the introduction of the individual feeding system.

Table 1: Production data high-tech farm and low cost farm.

	1998	1999	2000	2001	2002	2003	2004	Comp *) 2004
High-tech farm								
No of cows		69	74	75	76	81	76	85
Milk delivered (kg per year)		663900	754600	686700	712400	783500	692300	702300
Milk delivered (kg per cow per year)		9660	10200	9160	9370	9670	9100	8200
Low cost farm								
No of cows	52	47	47	47	47	53	59	55
Milk delivered (kg per year)	400000	390000	395000	390000	390000	400000	430000	412000
Milk delivered (kg per cow per year)	7700	8300	8400	8300	8300	7500	7300	8200

*) Comparison group high-tech farm: Results of LEI-farms on clay with 600.000-1.000.000 kg milk.
*) Comparison group low cost farm: Results of LEI-farms on clay with 300.000-500.000 kg milk.

Figure 1b shows that in 1999 and 2004 the low cost farm was able to meet the cost price of 34 eurocents per kg milk. Furthermore the result of the cost price was far below the cost price of the comparison group for the low cost farm.

Labour input
Table 2 shows the labour input (in hours per week) for both farms. Through the years it appeared to be very well possible to restrict labour input to (on average) 50 hours per week. Labour demand for the items 'foddercrops' (4%), 'machinery & buildings' (10%) and 'general management' (11%) were very similar for both farms. Most pronounced differences between both farms were visible for the items 'milking' (13% and 43% for the high-tech farm and the low cost farm, resp.), 'cow care' (40% and 25%) and 'feeding' (23% and 7%).

Table 2: Labour input high-tech farm and low cost farm and for the comparison groups (average number of working hours per week)

	1998	1999	2000	2001	2002	2003	2004	Comp *)
High-tech farm		48.4	50.5	48.4	47.5	47.8	48	86.5
Low cost farm	51.1	49.7	49.5	52.1	52.3	50.4	57	60.7

*) Comparison group high-tech farm: Results of LEI-farms (2004) on clay with 600.000-1.000.000 kg milk.
*) Comparison group Low cost farm: Results of LEI-farms (2004) on clay with 300.000-500.000 kg milk.

Mineral balance sheet
Table 3 shows the result of the mineral balance sheet (MINAS) for nitrogen for both farms. On the high-tech farm it was tried as long as possible to meet the levy-free thresholds without removing manure from the farm. Regarding this objective until 2001 there appeared to be

hardly any problem. Since then, however, red clover was introduced in order to reduce the input of N-fertilizer. In 2003 400 ton and in 2004 200 ton manure was removed from the farm in order to meet the levy-free thresholds for nitrogen and phosphate.
On the low cost farm it appeared very well possible to meet the final thresholds already from the start of the project onwards.

Table 3: Results of the mineral balance sheet and levy-free thresholds (MINAS) for nitrogen (kg N per ha) for the high-tech farm and the low cost farm during the years 1998 – 2004.

	1998	1999	2000	2001	2002	2003	2004
High-tech farm							
N-surplus		249	193	213	209	139	98
Levy-free N-threshold		254	229	213	197	197	166
Low cost farm							
N-surplus	180	143	92	82	103	63	81
Levy-free N-threshold 2005	174	174	174	174	174	174	174

Recent developments and points of further interest
On the high-tech farm the implementation of an automatic and individual feeding system started already in November 2003. Through this it will be tried to further optimize the farming system for individual cows. Attention will be paid to nutrition, cow traffic, milking and housing. Furthermore we will try to identify and implement other high-tech elements to optimize the system. New software may help the farm manager to make better use of all available data and information available. One way is by using a dynamic calculating model. With the model we can calculate for each individual cow the concentrate coefficient. This concentrate coefficient calculates how much the milk yield will increase when the cow is fed one kilogram of concentrate more. Or how much the milk yield will decrease when we feed the cow less concentrate. By using the day to day data on the milk yield from the automatic milking system the model responses to changes in the milk production of the cow when it is in heat. The same model is used to calculate what the optimum milking interval per cow is in order to have the highest capacity in the milking robot.
In 2004 an new mobile barn cleaner was introduced. This robot moves across the barn cleaning the slatted floors. It works with batteries and it follows the optimum route. Labour is saved.

As it was concluded that high producing HF-cows may not be the ideal type for this type of farm mainly because of poor body condition score due to very low concentrate input. The low cost farm has introduced Montbeliarde cows. Half of the herd consists of Montbeliarde since half 2003 and this makes a comparison with the HF-cows possible. Besides this the production factors milk quota and land have been fine tuned by increasing the quota to 425.000 kg milk. A new barn for young stock has been built and the floor of the barn for milking cows has been made safer by introducing the hybride floor. This floor is a combination of concrete and rubber in a so called ‘honeycomb-profile’.
The harvesting of maize is expensive and during the grazing period the feeding of maize also costs a lot of labour. In 2005 the maize silage was replaced by a starch rich concentrate which was fed in the milking parlour.

Which achievements realized?

Since the first results were presented the discussion about producing milk with a low cost price started on many dairy farms in the Netherlands. It was obvious that the production of milk is possible with low costs on two very different systems. By comparing economical figures including labour farmers are more aware of the amount of time they spend on their farm. The results of Low cost and High-tech farm show that the efficiency of labour can increase. Automation is a good way of decreasing the amount of labour. The automatic milking system is well known but now also the feeding of the cows is automated.
In the Netherlands there are more open and cheaper barns than before the introduction of the High-tech and Low cost farm. The discussion on what type of cow suites best on every farm has increased rapidly since the introduction of the Montebeliarde cows on the Low cost farm. Not longer INET but durability of the cow is the major genetic goal.

The Animal Sciences Group
The Animal Sciences Group (ASG) of Wageningen University & Research Center (WUR) was created in 2003 from ID-Lelystad, Applied Research and the Department of Animal Sciences of Wageningen University. The Animal Sciences Group is an intensive collaboration between science, application and actual practice. It conducts research for the Dutch livestock farming industry. The objectives are research on sustainable solutions and improvements for animal husbandry, improvements on image and income, and dissemination of knowledge. Much attention is given to cost management, animal welfare, organic agriculture and quality control. Another important topic is nature conservation on livestock farms.
The Waiboerhoeve is one of the Practical Centers of the Animal Sciences Group. Here throughout the year research is conducted on various topics, including milk production, forage quality and grassland production. Both the high-tech farm and the low cost farm are located at the Waiboerhoeve in Lelystad.