McDonald's Europe Flagship Farms

Dairy – Anton Stokman, Haanmeer 3, Koudum, Holland

Introduction

This case study shows how dairy production can be undertaken in a manner which maximises the welfare conditions for the cows, whilst reducing the impact on the environment and achieving an economic return. Here we highlight good practice in animal and employee welfare, species conservation and in reducing pollutant gas emissions.

The key initiatives undertaken at Anton Stokman's farm can be summarised as follows:

- The farm is a member of the farm assurance scheme Foqus which is audited and certified by an independent organisation and covers key aspects such as food safety, animal health and welfare. The scheme scores highly against the McDonald's Agricultural Assurance Programme for Dairy Farms.
- The farm first introduced robotic milking over 14 years ago. Anton believes that one of the most important benefits of this system is that it gives the cows "free choice" as to when they want to be milked and allows them to manage their own daily time schedules. This technology has improved milk yields and animal health, reduced somatic cell counts and has eliminated the labour requirement needed for milking.
- Dual chamber water beds are installed in all cow cubicles; these improve cow comfort and reduce injuries such as swollen hocks or hock lesions. Research shows that cows need to lie down for 10 to 12 hours per day (Albright, 2003) so this comfortable lying environment is of paramount importance. Another important aspect of the water bed is that it reduces the quantity of bedding required per cow and remains cleaner and more hygienic than other lying systems.
- Weekly foot–bathing of all cows and tri–annual professional foot trimming ensures that hoof care is at the forefront of animal care, and as a result, the incidence of lameness within the herd is extremely low. The farm recognises that control and treatment is crucially important as lameness is recognised as one of the major health and welfare issues among the European dairy sector.
- During the summer period an outdoor grass loafing field is provided for cows, this offers the cows the option to access the outside area, again providing "free choice".
- The grooved anti–slip floor reduces emission of ammonia from the slurry and with hourly removal has been shown to reduce ammonia emissions of slurry in the passageways by 30%.
- The addition of a new patented rubber slat cover which fits over the concrete slat provides a cushioned surface for the cows to walk on and the unique design limits ammonia gas escaping from the slurry holding tanks.
- 34 hectares of "nature fields" are provided for migrating wild geese to graze over the winter period, offering an important food source for these migrating birds.

> "Anton's dairy unit encompasses many great aspects of good practice and they are not just focused on one area of the business. The welfare of the cows is obviously one of the main areas of importance, and with Anton's principle of the 'free choice' system, allows the cow to choose what she wants to do and when, and in an environment which is designed to improve cow welfare and health. Reducing ammonia emissions is an important element of the livestock industry within the Netherlands and the farm has been implementing innovative ways of reducing their emissions. Anton has a refreshing outlook and a commitment in the long–term viability of the dairy industry which is great to see."
>
> Karl Williams, Flagship Farms Programme Manager, FAI

Summary of actions and benefits

The table below summarises the key areas of good practice displayed by Anton Stokman, and the benefits (EN **environmental** / EC **economic** / ET **ethical**) that arise from taking these actions.

	Action	Benefits
Certification/ Assurance	**Member of the Focus Milk Quality Scheme**	EN Ensures aspects of environmental regulation and good practice are met EC Milk and dairy products can be marketed under a programme which is recognised by the purchaser and consumer ET Independently audited on animal welfare, work and food health & safety
	Green Mark accredited	EN The first dairy farm in the Netherlands to be awarded the 'Green Facility Mark' EC by the Dutch government's Environmental Department
Animal health & welfare	**Robotic Milking**	EC Improves milk yields by up to 10%, and eliminates labour requirement/cost ET Allows cows to be milked at a more natural frequency dependent on stage of lactation and complements the fundamental aspect of the free choice system Staff are freed from the twice daily milking routine
	Dual chamber water beds	EC Water beds provide a comfortable lying area for cows ensuring they can lie down for the required 10–12 hours per day making them more productive, and reducing lameness EC Reduces the need to purchase large amounts of bedding material and subsequent disposal costs ET Increased lying times, improved cow comfort
	Passageways are autoscraped every hour	EN Limits the time slurry in the passageways can release ammonia, reducing nitrogen losses EC Cleaner passageways aid in hoof health and reduce lameness ET Reduces odour for local residents
	Weekly foot bathing & tri annual foot trimming	EC Good lameness control reduces the economic effects of lameness through lost production, treatment costs and higher culling rates ET Ensures lameness levels are kept to a minimum improving cow health and welfare
	Outdoor loafing area	EC By providing a suitable outdoor area for the cows helps improve cows' activity levels and provides an alternative surface to concrete to walk on ET Provides cows with an area to undertake social behaviours
	Milking cows provided with 16 hours of light therapy at 180 lumens	EC Improves animal productivity ET Improves health and welfare
	High COWEL– scores for accomodation & management	EN The COWEL system is a computer programme which calculates a score based EC on an assessment of an individual farms housing and management systems. A score is then allocates which shows how well the system provides ET for the health and welfare of the cows. Anton's farm scored 265 out of a possible maximum of 313
Sufficient high quality production	**New 280 dairy unit built in 2009**	EN 'Green' practices and technology incorporated into building EC More cow spaces built to enable expansion when quotas cease (in 2015) ET Secures the long term viability of the unit, and allows them to continue producing high quality milk
Agrotechnolo– gy	**Genetic selection**	EC Semen for artificial insemination is selected carefully to compliment the genetic potential of the dam and minimise carbon difficulties

Environment	**34 hectares of grassland provided as winter feeding habitat**	EN Wild geese are provided with a large area of grassland to graze during their winter migration EC The farm is compensated for the lost grassland productivity of the habitat area
	Grooved floor design in passageways	EN Reduces ammonia emissions from slurry in passageways by 30% EC Reducing ammonia emissions increases nitrogen content of slurry ET Limiting ammonia emissions reduces the odour levels for local residents
	Convex rubber slat cover with interlocking flaps	EN The interlocking flaps have been shown to reduce ammonia emissions from the building by 35% ET Cow comfort is increased, and lowered ammonia emissions reduces the odour levels for local residents

Anton (second from right) showing visitors from McDonald's and FrieslandCampina around his farm

Background

The Netherlands covers an area of 3.5 million hectares and is one of the smallest and most densely populated countries in the world. It is also one of the largest exporters of agricultural products. The country has always been at the forefront of development and application of new agricultural techniques, and has made good use of its available resources.

Anton Stokman's parents purchased the dairy unit in Friesland in 1964. Anton grew up on the farm and took over the running of the unit in 1985. Anton's vision for the farm was to increase the number of milking cows. Over the following 10 years he expanded the herd to 120 cows, and in 1998, purchased two Lely robotic milkers. During this time period water beds were installed in the cubicles with the aim to improve cow comfort.

A purpose built 280–cow place dairy facility was constructed in 2009. Although there are currently only 180 cows in the herd, the benefit of building this larger capacity shed will enable rapid expansion once quotas are phased out (in 2015). The building consists of many of the long–standing good practices (robotic milking and water beds) and this project has enabled other new developments to be included in the facility including the philosophy of "free choice" for the cow.

Facts: Dairy farming in the Netherlands
Of the 3.5 million hectares in Holland around 1.9 million hectares is farmland. Just under half of this is pasture devoted almost entirely to dairy farming, and in addition to this, approximately 300,000 hectares of arable land is used for the production of feed crops for cattle (of which 230,000 hectares are for fodder, maize, etc.). Dairy farming in the Netherlands occurs in diverse conditions and on various soil types, with the mean annual rainfall being more than 700 millimetres.
There are 21,000 dairy farms, which together have a dairy herd of 1.4 million and a total milk quota of 11 thousand million kilograms. One third of the dairy farms are responsible for two thirds of the milk produced. More than 80% of the dairy farms are specialist farms. On average these farms have about 60 dairy cows, a milk quota of 525,000 kilograms and around 30 hectares under cultivation. The farm work is carried out by the equivalent of 1.6 full–time workers, usually including the farmer and one or more family members. Dairy farming, including milk delivery and processing, provides almost 160,000 working year's employment and has an annual gross turnover of 6.35 billion Euros.

(Source: Agricultural Office of the Netherlands Embassy, 1998. Eurostat, Farm structure in Netherlands 115/2008)

Anton works closely with the neighbouring farming community to promote his philosophy of "free choice" that aims to satisfy the different needs of each individual cow. By working together, the farmers in the Koudom region now have 250 cows living in "free choice" systems and several farms have constructed similar systems based around Anton's barn design.

The herd is comprised of Holstein cows which calve all year round, producing an average milk yield of 8600 kg, at 4.35% fat and 3.55% protein. The farm is situated 8km away from the dairy where the milk is delivered and processed.

Anton is continuously looking to improve his enterprise with new developments and innovations. Future projects include the installation of a biogas system to improve the energy efficiency of the farm, and a custom–made apparatus for transportation and handling of cows that leave the farm, which improves comfort and reduces stress in the animals.

Certification / assurance

The farm is a member of the Foqus Farm Assurance Scheme, which was initially called Qarant and was set up by Royal Friesland Foods (a Dutch dairy processing co–operative) in response to European regulations (EU regulation 178–2002, the General Food Law). This quality assurance programme starts at dairy farm level and covers milking process, storage of milk, animal health and welfare, medication, feed and water, milk quality, administration and registration. These requirements deliver high food safety, animal health and welfare, and have been developed to take into account the demands of consumers and retailers. The scheme is independently audited (Certification to EN45011) and is therefore an important measure in providing confidence to consumers and retailers that high quality standards are being fulfilled.

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Membership of a quality assurance programme delivers high standards in animal welfare and food safety, while meeting the demands of consumers

Green Mark Accredited

The Green Mark Facility is awarded by the Dutch Government's Environmental Department, and the criteria to be awarded the mark are as follows:

- The project is the best environmental solution to a particular problem
- The project must contribute significantly to the protection of the environment, including nature and forest

Anton's farm was the first dairy unit in the Netherlands to be accredited with the 'Green Facility Mark' with the declaration being awarded under 'innovative projects'.

Animal health & welfare

Robotic Milking

The farm is a major advocate of robotic milking; having had the first two robots installed over fourteen years ago, the farm purchased four new Lely robotic units in 2010 for the dairy facility. All the cows are individually identified by a micro–chip which is inserted inside the cow's neck collar. As they enter the robotic milking stall they are immediately identified by the computer, which calculates whether the cow needs to be milked or not. If the cow requires milking she is fed a pre–determined amount of food and then the system's laser scans the cows' teats, cleans them and automatically attaches the clusters.

The benefits of robotic milking are:

- Labour requirement at milking is eliminated, as the whole milking operation is fully automated, leaving staff more time to monitor the cows and undertake other management and husbandry routines. The system also improves employee / employer free–time and social life, this makes it easier to retain and employ the high quality staff required to run a successful dairy unit.
- Individual animals can have their milking frequency increased depending on their stage of lactation and yield, which in turn improves milk yields *(Pearson et al., 1979; Stelwagen, 2001)*, milking frequency can be increased upto five times per day if necessary.

- Each quarter of the udder is milked individually (which is not the case for conventional milking systems), this reduces over and under milking as each quarter is monitored and milked individually.
- Milking speed, milk conductivity and yield are monitored at every milking, and this data is then used as an early warning system to identify potential health problems.
- The cows are able to choose when they are milked, allowing the implementation of a 'free choice' dairy system.

The reduction in time spent waiting to be milked and being milked has a big beneficial impact on the cows and allows them more time to socialise, eat and rest. Cows require 10–12 hours of lying and resting time per day which can take preference over feeding, if time is restricted (Metz 1985). High lactation dairy cows must be able to eat whenever they require as this provides nutrition for optimal cow health, welfare and productivity, which improve farm economics. With increased time spent feeding, improved milk yield can be achieved (Shabi et al. 2005). Therefore performance and farm economics may be improved if the dairy cow has this extra time to feed. The whole ethos of robotic milking also readily feeds into the concept of a 'free choice' system for the cows, as they can decide when they want to be milked, feed and to rest.

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The introduction of automatic milking machines has provided cows with 'free choice' and improved behavioural conditions, while also increasing yield and improving employee welfare

Benefits of robotic milking

"Adopting an automatic milking system on a Finnish dairy farm decreased the hours spent on animal husbandry by approximately 30 per cent. When comparing a milking parlour and the automatic milking system, the main economic benefit clearly results from the decrease in labour costs in automatic milking. In terms of economic profitability, the net return in automatic milking remains above that of the milking parlour system. A more flexible working time distributes the workload evenly during busy cultivation periods."

Source: Terhi Latvala – Antti Suokannas, Adoption of Automatic Milking System: Profitability and Reasons For Adoption, 2005

Water beds

The farm fitted water beds over 10 years ago in the previous cubicle shed with great success. So when the decision to construct the new housing facility was taken, the lying option for the dairy cows was once again water beds.

A major improvement has been the introduction of the "Dual chamber". These specifically provide a cushioned area for the cow's knees (which is especially important to the cow when laying and standing) and a separate pocket for the body and hind legs. Other bedding materials, like crushed rubber and canvas foam beds, can form compressed pockets – these allow pools of urine and milk to collect, in which bacteria can grow and cause environmental mastitis.

The benefit of the dual chamber waterbed is that it returns to its original convex manufactured shape, meaning moisture flows away from the bed surface, not only providing a drier more hygienic lying surface but also meaning that the requirement for bedding material is reduced. Several studies have shown that waterbeds provide a surface which reduces the incidence of injury, and provide consistent long term comfort, over other forms of bedding materials.

> "The study compared 38 farms with rubber– filled mattresses, 27 with sand bedding and 29 with waterbeds. They scored cows for cleanliness, and lesions and swelling on their front and rear legs. Among these herds, 72 per cent of cows in herds bedded on mattresses had hairless spots on their hocks, and 17 per cent had swollen lesions. Hock damage was rare in sand–bedded herds–only 25 per cent had hairless spots and less than three per cent had swollen hocks. At 35 per cent, cows on waterbeds had less than half the lesions of those on mattresses, and three per cent had swollen hocks. Although knee injuries were uncommon, they occurred most frequently in sand–bedded herds using very course recycled sand. Cows in sand–bedded stalls were slightly dirtier than those on waterbeds or rubber–filled mattresses. There was no clear difference in somatic cell counts, and cull rates were lowest for herds with waterbeds and highest for those with mattresses"
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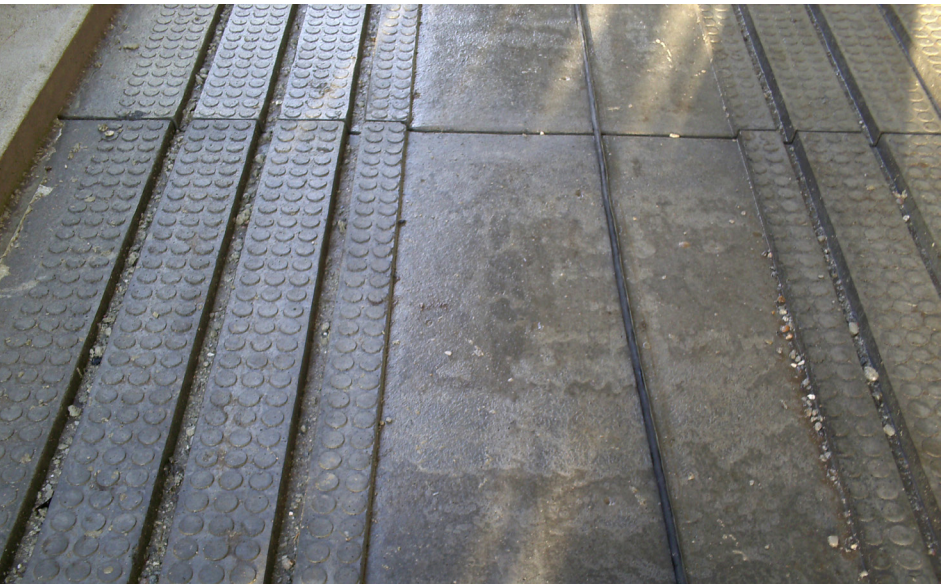
> *(Source: W. K. Fulwider et al, Influence of Free–Stall Base on Tarsal Joint Lesions and Hygiene in Dairy Cows, 2007)*

Hourly slurry removal

The flooring in the barn passageways is automatically scraped every hour. This stops the 'wave effect' of a large amount of slurry being pushed through the building, which ultimately increases the contamination of the cows' feet and legs. The corrosive mixture of faeces and urine has a very damaging effect on the hoof and as a result lameness may increase.



The environmental benefit of hourly slurry removal is in the reduction of ammonia gases which are generated from the cows' faeces and urine mixing in the passageways (see: Flooring and ammonia emissions).

Reducing lameness

There should be systems for monitoring the prevalence of lameness by scoring locomotion and foot lesions every 3 to 6 months in all dairy herds. The European Food Safety Authority has stated that because of the high risk of lameness in dairy cattle all dairy farmers should implement a lameness prevention programme. It further recommends that there should be systems for monitoring the prevalence of lameness by scoring locomotion and foot lesions every 3 to 6 months in all dairy herds. On farms with a high prevalence of recognisable locomotor difficulties, e.g. approaching 10%, there should be improvement of housing conditions, genetic strain and management practices.

(Source: EFSA Report, Overall effects of farming systems on dairy cow welfare and disease, 2009)

Facts: the cost of lameness

According to researchers participating in Welfare Quality®, farmers significantly underestimate the amount of lameness in their herds and in doing so, not only risk reducing the welfare of their animals but also losing some of their profits at the same time. Though farmers estimate about 5% to 10% of their dairy cows suffer from lameness, the average is closer to 25% of the herd. Lameness reduces the efficiency of a cow's milk production, with an estimated average loss of €200 per cow, per year. In other words, this welfare problem accounts for a loss of 5% to 10% of a farmer's annual income per cow.

(Source: Welfare Quality, Reducing Lameness in Dairy Cows)

Over 12 years ago, Anton implemented a strict routine of weekly foot–bathing. Firstly, all the cows walk through a foot–bath of water to clean the hooves (and this tends to stimulate cows which want to dung and avoids contaminating the treatment bath) and then through a second bath with a solution of formalin. This routine has been very successful as there are no infectious hoof conditions within the herd and recorded levels of lameness are very low. Locomotion scoring is undertaken six times per year (along with body condition scoring), which allows the farm to identify any cows which require additional treatment. All cows are inspected and trimmed (as required) by a professional foot–trimmer three times per year, allowing close monitoring of all cows feet on a regular basis by a trained and competent professional. In 2012, out of 295 animals on the unit, 14 were treated specifically for lameness / leg problems (this equates to 4.7%) showing that the practical measures undertaken on the farm are working.

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Specialist measures are taken to reduce the incidence of leg injury and lameness; including weekly foot bathing and automatic hourly scraping of the dairy house flooring

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The cost of a typical case of lameness is €200

(Source: SAC Technical Note 599, Preventing Lameness in Dairy Cows, 2007)

Outdoor loafing

Outdoor loafing areas provide space for the dairy cows to exhibit their natural behaviours as well as being able to avoid dominant cows. The additional space provides an area for the animals to interact and to show oestrus behaviour without the fear of colliding with the buildings internal fixtures and fitting, which makes oestrus detection for the farm easier. Social interactions and bonding are also reinforced by cows grooming each other, and these behaviours that are observed more often in loafing areas.

The farm provides an outdoor grass loafing area for the cows during the spring/summer period. The cows are offered this on a 'free choice' basis and can access the loafing area whilst still being able to return to the building for milking and feeding. When the weather is particularly hot, cows generally prefer to return to the barn as it provides shade and is cooler.

Anton was also keen that the loafing paddock be adapted to provide different environmental conditions for the cows. A shallow pool filled with water and a small embankment has also been constructed which provides an area for the cows to climb and exercise, and although there is no evidence that these facilities provide any definitive benefits to the cows, it is a testament to Anton's imagination and his ability to innovate.

> "Highly intensive dairy systems (e.g. zero–grazing) are practiced in both the UK and Holland. In these systems research suggest that welfare risks relate less to the issue of behavioural restriction and more to the physical strains imposed on the cow through being housed for long periods on hard surfaces. Zero–grazing systems are associated with higher than average lameness scores and knee swellings relative to other farm types"
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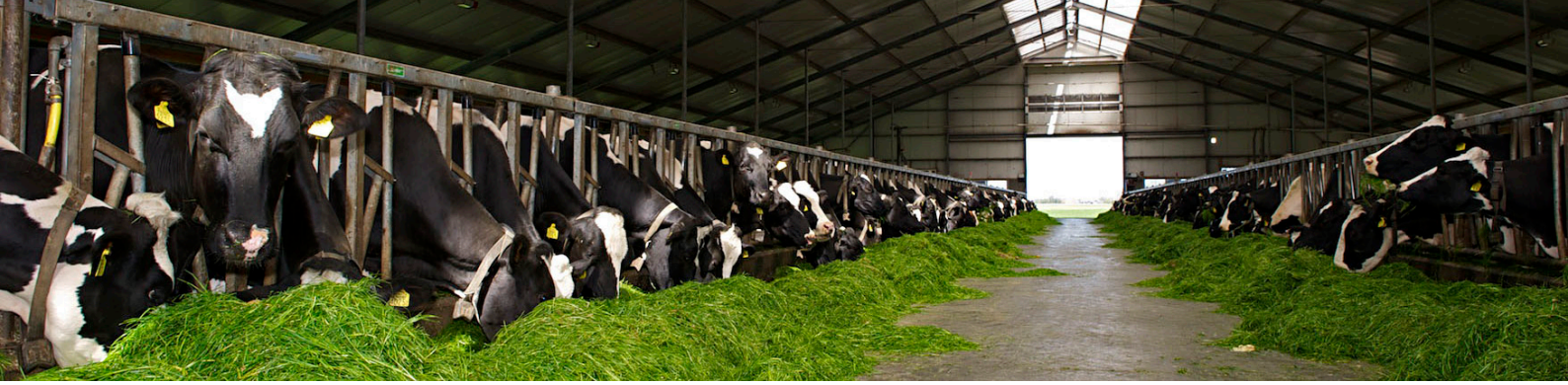
> *(Source: DEFRA Project AW1006, Behavioural studies relating to the welfare of intensively managed dairy cows)*



Light therapy

Research suggests that improved light levels can increase milk yields and cattle growth rates. Milk yield and feed intake are optimised by light periods of 16 to 18 hours per day at a level of 160–200 lux. Researchers at Wageningen University have studied the effects of light intensity, spectrum and duration on dairy cows (see box). Whilst lighting conditions are usually specified to provide optimum working conditions for the stockman, the report explains that cows of different ages and in different milking phases are also considerably affected by the light regime provided. As a result of these findings Wageningen University has issued guidelines recommending that dairy cattle are provided with 14–16 hours of 120–200 lux per day, with at least 6 hours of darkness.

The farm has now implemented the new lighting regime in the barn with the aim of improving the health and productivity of the cows. Anton is using high–pressure Sodium (Natrium) light bulbs, as the colour rendering properties of the light are superior, and they are very energy efficient and cost effective to run. The winter lighting regime aims to supply the lactating cows with a light level of 180 lux for 16 hours per day.

Facts: benefits of improved lighting conditions on milk yields

Heifers exposed to a light regime of 16 hours light and 8 hours dark reach puberty earlier and at a lower weight than cows provided with reduced lighting levels and identical feeds. Additionally, providing a cow with increased light hours after the calving period accelerates the time within which oestrus begins. These differences are believed to be caused by changes in the blood serum levels of key hormones that affect the animal's performance in response to increases in light intensity. Specifically, cows exposed to longer daylight hours had reduced levels of melatonin and increased levels of the Insulin–Like Growth Factor–1 (IGF–1). In milking cows these same hormones are thought to cause an increase in milk production of 6–15% when the daylight period is extended to 16 hours. Conversely, reducing daylight hours for dry cows has the effect of increasing milk production in the following season.

(Practical Report Rundvee 34; W UR, 2003)

EC

There is an increase in milk production of 6–15% when the daylight period is extended to 16 hours

COWEL Scoring system

Animals have various behavioural and physiological needs that are important for welfare. Fulfilment of these needs depends on the quality of housing, management and animal characteristics. The objective of this study was to develop a model to assign welfare scores to husbandry systems for dairy cattle, based on scientific results, and thereby support the design of new, welfare–friendly systems.

The COWEL model contains 2,343 statements on dairy cattle welfare from 476 sources found during a literature survey. The model was applied to four husbandry systems, namely a tie–stall, cubicle housing, a straw yard and a pasture–based system. The welfare scores, calculated by COWEL for these husbandry systems, correspond with the general opinion about these systems. A tie–stall receives a low and a pasture–based system a high welfare score: 211 and 271, respectively. A husbandry system can receive a maximum of 313 on the welfare scale of COWEL.

Facts: COWEL scoring system

COWEL is a computer–based decision support system that contains attributes regarding housing and management conditions. These attributes are technical specifications that contain various technical units called levels. These levels are ranked from best–to–worst regarding welfare, based on scientific information about animal–based parameters. This information, inserted in the model as statements, was weighted depending on the impact it has on welfare by using weighting categories.

Thereafter, a weighting factor was calculated for each attribute which determines how important an attribute is for welfare.

(Source: COWEL: a decision support system to assess welfare of husbandry systems for dairy cattle Ursinus, W.W.; Schepers, F.; Mol, R.M. de; Bracke, M.B.M.; Metz, J.H.M.; Groot Koerkamp, P.W.G.)

Anton's dairy system was assessed via the COWEL system and received a score of 265, which according to the comment in the previous section, 'a pasture–based system receives a high welfare score of 271', which demonstrates the score achieved by Anton's farm is excellent for the 'free choice' system he operates.

Sufficient high quality production

New building

The new dairy unit was constructed in 2009 and has the capability to house 280 cows, although at present there are only 180 cows on the unit. The reason for building the larger capacity unit is for an investment in the future of dairy farming and the family business. This means in 2015, when milk quotas are finally abolished, the farm will be able to rapidly expand the herd to up to 280 cows to take advantage of these new market conditions. This has also allowed Anton to introduce several new systems and practices to improve the barn's environmental credentials, and the health and welfare of the cows (see sections on robotic milking, waterbeds, light therapy, flooring and ammonia emissions)

Anton's son is currently studying at Agricultural University and when he has completed the course he will come back home into the family business; therefore by investing in the farm now Anton is ensuring the sustainability of the business for the next generation.

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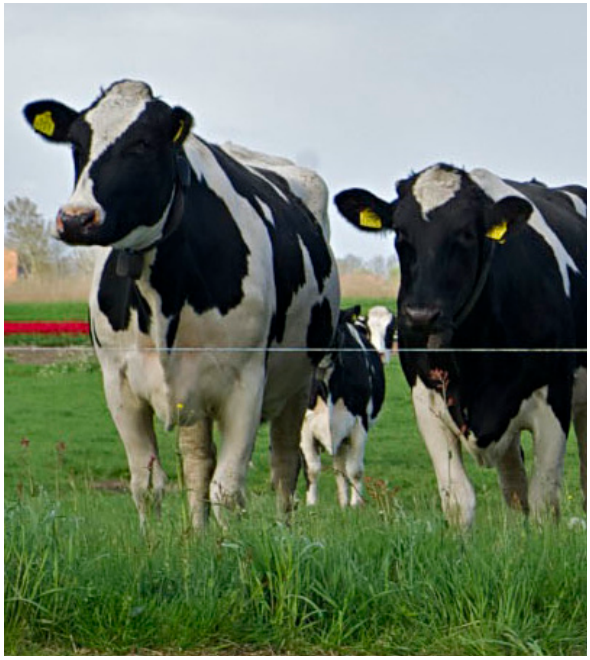
Modern, well–designed facilities enable the cows to demonstrate their natural behaviours and free choice in a safe environment. The floor design of the facilities also minimises ammonia emissions.

Agrotechnology

Genetic Selection

The genetic component underlying milk yield has been found to be positively correlated with the incidence of lameness, mastitis, reproductive disorders and metabolic disorders. In order to improve dairy cow welfare there is an urgent need to promote changes in the criteria used for genetic selection in the dairy industry. Priority should be given to fitness and welfare traits when these may conflict with selection for milk yield.



Anton uses bulls that are proven to sire small, easy–calving offspring. The farm has reduced the incidence of calving difficulties, with only around 5 percent of the herd requiring assistance at birth. Other traits selected for in breeding bulls include longevity, productivity (including milking speed) and health status.

The average number of inseminations per cow is 2.16, and the calving interval is currently 389 days , although this is expected to rise to 393 days in the future (see graph below).

EC

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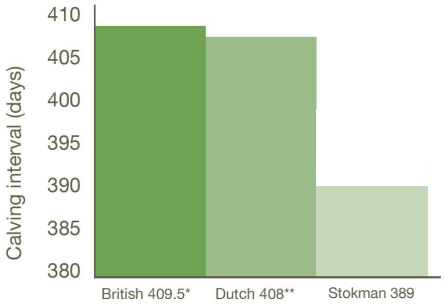
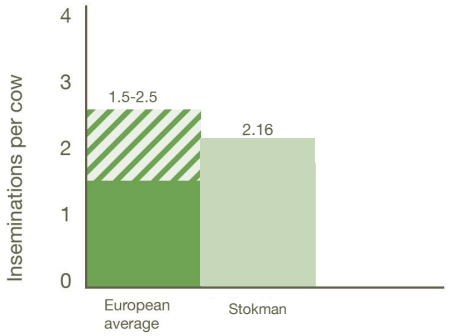
Genetic selection for improved fertility, health and longevity is likely to improve welfare and lead to greater profit for the farmer



*average across main breeds ** van Arendonk et al, 2003



Environment

Habitat area

The Netherlands is one of the most densely populated countries in the world and this creates pressure on wildlife populations in search of habitats for feeding and breeding. In these circumstances, it is critical that the interests of wildlife are not overlooked in the response to increasing farm economics. The farm manages an area of 90 hectares, 34 of which are set aside to be grazed by migratory wild geese over the winter period. This important habitat provides a much needed feeding zone for these birds. In return for this grazing habitat the farm receives an area payment as compensation for the lost grass production, which is in the region of 335–1100kg DM/Ha* for first cut silage or early grazing, although there are no yield losses after first cut.

**Source: G.W.T.A Groot Bruinderink, 1989*

Grooved flooring to reduce ammonia emissions

The most common housing for dairy cows, particularly on larger farms, is the free stall system. Cubicles are provided for resting and animals have the freedom to move to the feeding area on an open floor. Manure is primarily deposited onto a solid floor that is frequently scraped or flushed or a slatted floor from which manure drains between the slats into a pit below. Nitrogen emission from these floor systems is nearly all in the form of ammonia. Under warm conditions, with faecal and urine materials well–mixed on the floor, nitrogen loss is high, with most of the urea transforming into ammonia and volatilising into the atmosphere. Under cold winter conditions, nitrogen loss is relatively low. On average, about 16% of the excreted nitrogen is lost from the free stall area.

The farm's dairy building incorporates a floor design with a gutter feature allowing improved separation of urine and faeces. The urine drains into the gutters away from the faeces and therefore reduces the amount of mixing that occurs. Increasing the speed of urine removal into the manure pit lowers the pH and reduces ammonia emissions from the slurry. Convex rubber mats are fitted to the slatted floor that prevent air exchange between the barn and the manure pit to further reduce emissions, whilst Automatically Controlled Natural Ventilation (ACNV) controls the housing airflow.

Facts: benefits of groved flooring

"On solid floors, floor shape and surface characteristics can influence ammonia loss. A small, 3% slope of the floor allows urine to drain away from the faeces, reducing ammonia emission by 21% compared to solid or slatted level floors (Braam et al., 1997a). A double–sloped floor with a urine gutter in the centre reduced ammonia emissions by 50% (Braam et al., 1997b). A grooved solid floor system was evaluated that included perforations through the floor. The grooves enabled urine to move away from faecal material and then drain through the floor perforations. Compared to a traditional slatted floor system, the grooved and perforated floor reduced ammonia emissions by 46%."

(Source: Swierstra et al., 2001; C.A. Rotz, Management to reduce nitrogen losses in animal production)

To measure release of odour and greenhouse gases from the "free choice" housing systems, the farm undertook research ("Measuring Program for integral sustainable stables") with Wageningen University. The study showed that, when the cows are housed, a single "free choice" barn, reduced ammonia emissions by 35%, odour by 50% and methane by 50%. Average total emission reductions over the four barns on the farm were 25% for ammonia and 50% for methane. The study has demonstrated that novel housing systems can reduce environmental air pollutants from dairy farming, and has provided a model protocol for measuring other systems in the Netherlands and Europe (Rapport 614, WU R, 2012).

These measures are particularly important since the Dutch Government introduced strict regulations for reducing ammonia emissions for 2010. Plans are underway to construct an anaerobic digester on the farm, to process all the herd slurry (other waste products may be included). The methane produced from this system will then be piped to the processing nearby dairy where it will be used as a flammable gas (in conjunction with natural gas) to heat water to produce steam required by the dairy.

Facts: ammonia pollution

"Ammonia is an air pollutant largely emitted from agriculture that threatens significant areas of valuable habitats. Ammonia is a colourless gas composed of nitrogen (N) and hydrogen (H) with the chemical symbol NH3. The gas is released mainly during naturally occurring processes, i.e. the breakdown of the urea excreted by farm livestock and other mammals. Ammonia is very soluble in water and readily reacts with other substances in the atmosphere to form ammonium (NH4+) compounds such as ammonium sulphate and ammonium nitrate. Following the emission of ammonia gas to the atmosphere, it may be deposited to land either as gas or as ammonium–N compounds in rainfall. This can have profound effects on natural ecosystems."

(Source: DEFRA, Ammonia in the UK, 2002)

Appendix 1 – Good Practice Matrix for Anton Stokman

The following matrix has been developed by McDonald's to help assess the sustainability of the agricultural production within the supply chain. Flagship farms have been identified that demonstrate best practice in one or more of the 17 key areas in the matrix, whilst also operating to general high agricultural standards in all other areas.

A ✓ in the matrix below indicates good practices demonstrated in this case study.

Ethical (Acceptable Practices) ET

Human health & welfare ✓
- i Employee health & welfare ✓
- ii Food safety ✓

Animal health & welfare ✓
- i Nutrition
- ii Medication & growth promoters
- iii Genetic selection ✓
- iv Animal cloning
- v Husbandry
- vi Transport ✓
- vii Slaughter

Business ethics & supplier relationships

Rural landscape preservation

Environment (protecting the planet) EN

Climate change
- i Greenhouse gas emissions
- ii Energy efficiency & renewables

Natural resources – soil
- i Soil fertility & health
- ii Soil erosion, desertification & salinisation
- iii Soil contamination

Natural resources – water
- i Water pollution
- ii Water usage efficiency

Natural resources – air ✓
- i Air emissions ✓

Agrotechnology
- i Agrochemical usage
- ii Bioconcentration & persistent organic pollutants
- iii Genetically modified organisms

Ecosystem protection ✓
- i High Conservation Value Land (HCVL)
- ii Habitat & species preservation ✓

Waste
- i Production waste
- ii Hazardous waste
- iii Waste to landfill

Economics (long–term economic viability) EC

Sufficient high quality production ✓
- i Producer income security & access to market
- ii Agricultural input costs ✓
- iii Crop & livestock disease ✓

Community investment
- i Local employment & sourcing
- ii Support for community programmes