A welfare assessment system for dairy cows on pasture

And the comparison to a welfare scoring system for cows in cubicles/stalls

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Abstract

In Uruguay, and other countries with a warm climate, cows are held on pasture all year long. To score the welfare of the cows in countries like Uruguay the current system for cows in cubicles was converted to a system for farmers who keep their cows all year long on pasture. During six weeks 34 dairy cow farms in Uruguay with Holstein Friesian cows were studied in order to make a welfare scoring system for pasture-based dairy farms that is comparable with the barn-based cow comfort system from van Eerdenburg et al. (2009).[12] The study was divided into seven phases. The first two phases consisted of studying the life of cows in cubicles and on pasture. Then the barn-based scoring system was converted and new parameters were added to the system. Subsequently it was determined how to measure the parameters, and points were assigned. In the final phase the scoring system was validated. The result is a scoring system with 86 parameters. These parameters are divided in 13 categories: general, milking parlour and waiting area, waiting area, milking parlour, exit milking parlour, water, feeding sites, walkways, loading site, pastures, farmer and staff, environmental management and animal health. This paper mainly focuses on the categories which include environmental factors that influence the welfare of cows.
The validation of the system showed that scores were produced that were in accordance with the impression of experts in the field. The maximum amount of points to be obtained is 500. The maximum score is similar for the barn-based system and the pasture-based system. This makes it possible to compare the scores between farms from both systems.
More research is required in order to improve and fine tune the scoring system and to find an answer to the question: Are cows that live on pasture happier than cows that live in a barn?

Introduction

Since a long time people are caring for the welfare of animals. In 1965 Ruth Harrison wrote the book 'Animal Machines' to get our attention with respect to the welfare of livestock.[11, 23] But how can we define animal welfare? This is proven to be a difficult question to answer. The key words are feeling happy and being healthy. The Brambell Committee was one of the first who designed a definition after the publication of Harrison's Animal Machines in 1965. According to this committee welfare is: *a wide term that embraces both the physical and mental well-being of the animal. Any attempt to evaluate welfare, therefore, must take into account the scientific evidence available concerning the feelings of animals that can be derived from their structure and functions and also from their behavior.*[11] Nowadays the five freedoms, compiled by the Farm Animal Welfare Council in 1993, are there to give us some guidance. They show the minimum requirements the farmer should provide for his animals, they include:

1. Being free from thirst, hunger and malnutrition,
2. being free from physical and physiological discomfort,
3. being free from pain, injuries and illnesses,
4. being free to perform the normal behaviour, and
5. being free from anxiety and chronic stress.[23, 49]

Symptoms of chronic stress could be disturbed behaviour, organ damage, decreased reproduction, increased disease susceptibility, fear and/or pain expressions or decreased vitality.[23]

In the past decades, keeping livestock in the western society is characterized by scale enlargement, specialization and mechanization of production. This means that farmers see their animals more as products and not as living creatures.[23] Maybe this is why in the western society the last few years animal welfare has become more important. The consumer wants animal-friendly produced meat and in the Netherlands we even have got the “Partij voor de Dieren” (= party for the animals), to stand up for animal rights and animal welfare in the parliament. For the farmer it is also important to keep his animals under the best conditions as possible, because the better the welfare of the cow, the higher the yield will be. In other words: 'a happy cow, a happy farmer'. A happy cow produces more milk and more milk means more money for the farmer. On the contrary we have to ask ourselves: “is a cow with a very high milk production happier than a cow with an average milk production?” According to Abeni and Bertoni (2008) there is a relationship between high producing herds and reduced levels of welfare.[1]
In the Netherlands the main way of keeping cows is in cubicles. Van Eerdenburg et al. (2009) developed a scoring system for these barn-based dairy cows. It can be used on every farm where they keep cows in cubicles. This system consists of multiple parameters that are important for cow comfort on dairy farms. Van Eerdenburg et al. examined if there is a relationship between the cow-comfort (score) and the milk production. The results showed some relations between comfort scores and milk production.[12]
In other countries, like Uruguay, cows are the whole year around held on pasture due to the difference in climate. To score the welfare of the cows in countries like Uruguay it is necessary to convert the current system for cows in cubicles to a system for farmers who keep their cows all year long on pasture. In this paper a scoring system is described for cows on pasture. The differences between the two systems are also addressed.
Veterinarians may use the scoring system to advise farmers where to make changes in the environment or, for example, how to handle the animals differently to get a better score. In this way welfare can easily be improved.

Materials and Methods

Farms

This study was conducted in November 2009 and December 2009.
34 dairy farms were visited in Uruguay by two investigators to avoid subjective scoring. The farms were visited during 6 weeks, started on the 16th of November until the 29th of December.
The investigators travelled along with a veterinarian who is a mastitis expert. At all the farms they were working with Holstein Friesian dairy cows.

Phases

The research was divided in several phases.

- Phase 0: Studying the life of cows in cubicles.
- Phase 1: Studying the life of cows on pasture.
- Phase 2: Converting the barn-based scoring system.
- Phase 3: Adding new parameters.
- Phase 4: Determining how to measure the parameters.
- Phase 5: Assigning points to the parameters.
- Phase 6: Validating the scoring system

Phase 0: Studying the life of cows in cubicles

Before studying the life of cows on pasture in Uruguay, it is necessary to know how cows are kept in the Netherlands. The studying took place at a Dutch farm for two days. In this way it was possible to get an idea of the work that needs to be done at a barn-based farm and to see how the cows live there.

Phase 1: Studying the life of cows on pasture

To set up a comparable scoring system it is important to know exactly how the cows live in Uruguay. Five farms were visited in order to observe the cows during the day to find out what the life of a cow looks like. The environment, the cows, the waiting area and milking parlour were studied by taking pictures and making notes. It was important to determine the distribution of the time to determine how long the cows are in the pasture and how long the whole milking process takes, this includes getting the cows out of the pasture until bringing them back.

Phase 2: Converting the barn-based scoring system.

The scoring system for cows on pasture is based on the scoring system for barn-based dairy cows. To make a comparable system it had to be a similar system.
For all the various parameters of the barn-based scoring system was decided if it was important and useful for the new scoring system. Barn-specific parameters, like cubicle dimensions, were not applicable and therefore deleted from the system.

Phase 3: Adding new parameters.

When converting a barn-based scoring system, some new parameters need to be added to the system, for example the distance to the feeding places. After studying the cows for a while, it appeared that certain cows were negatively affected in their welfare as indicated by signs of lameness, skin lesions, the eyes not being shiny and lean cows. Some cows were restless, got scared very easily and they tried to get away when they were approached by human beings. The parameters that are causing this are added to the system.

Phase 4: Determine how to measure the parameters.
After collecting all the parameters and put them in the system it was important to determine how to measure them.
For parameters like locomotion, body condition score, rumen fill and cleanliness of the cow we used existing scoring systems.[6, 14, 34, 51] Body condition score, rumen fill and locomotion score can all be easily found in the book Cowsignals.[22] Other parameters like water temperature and the speed of cows walking are measured with measuring equipment. For behavioural parameters the possible reactions of the cow were investigated. This was also done for some environmental parameters, but than by documenting the situations seen at the farms. The different reactions and sights that were documented became options to choose from. For example, for the cleanliness of the surface of the feeding site this resulted in: clean, a small layer of faeces/mud, or a big layer of faeces/mud.
During the study, pictures were made of the situations encountered. By using these pictures it was easier to choose between the different options.
Also a questionnaire was designed to get important information about some parameters, especially about animal health. This was necessary because, for example, it cannot be determined how many cows have had mastitis in one year during a single farm visit. For the questionnaire see appendix.

Phase 5: Assigning points to the parameters.
After setting up the system, a score was assigned to every parameter.
The height of the score depended on how important the parameter is for the welfare of the cow. For example the percentage of mastitis is more important in comparison to the floor of the feeding places. Therefore, a higher score is awarded to the percentage of mastitis. However mastitis usually lasts a few days, while a bad floor is bothering the cows every day. This is taken into account, because the floor is used in several parameters. This means the floor of the feeding places gets less points then mastitis, but the floor also gets points in the category waiting room, milking parlour, outlet and walkways. The total score for floor is therefore higher than the total score for mastitis.

To make the pasture-based system comparable to the stall-based system it was important to compare the scores of the parameters.
For example, behaviour and time in the waiting room is as important for pasture-based cows as it is for barn-based cows. But the walkways are more important for pasture-based cows than for barn-based cows. Therefore it gets a higher score assigned in the new scoring system. This is because the pasture-based cows have to walk much more on the walkways than barn-based cows have to.

Some parameters are divided into different options. Each option has a different score. The best option gets the highest score.
For example the maximum score for cow behaviour is 5 points.

Cow behaviour is divided in 3 options:	curious	5 points
	not fearful	3 points
	fearful	0 points

Some parameters that are about cow health are very important. If the health of the cows is very bad, points are subtracted.

% milk fever per year

0%	→	5 points
0 – 5%	→	0 points

5 – 10%	→	-2 points
10 – 15%	→	-5 points
> 15%	→	-10 points

Every category consists of several parameters. For all those parameters there is a score. There is a maximum and a minimum score for each category. If the minimum score is not reached, the difference between the score and the minimum needs to be subtracted from the total score. For example:

Category general

maximum points	20
minimum points	10
score farm	8
total score	6

Phase 6: Validating the scoring system

The last phase consists of validating the scoring system.
The scoring system was used at several farms. Together with the veterinarian a ranking of the farms was made. The farm which seemed to have the 'happiest' cows was number 1 and the farm which seemed to have the 'saddest' cows was the lowest in ranking.
After the ranking the scores were determined. If the system would have the right scores, the number 1 farm would have the highest score and the farm lowest in ranking would have the lowest score.
During the study a score sheet was made. This sheet can be used when a farm is visited. For the score sheet see appendix.

Results

The pasture-based scoring system for dairy cows

Table 1 summarizes the various parameters of interest for cow comfort on pasture-based dairy farms with the number of points that can be acquired. The points can be summed per chapter, and counted for the entire farm.

Table 1 Scoring system for cow comfort on the dairy farm

	Minimum	Maximum	Points
General	**10**	**20**	
Fear behaviour		5	
Stretching when raising from the pasture		3	
Tails are hanging straight and relaxed		3	
Broken tails		0 (-100)	
Bellowing		4	
Environmental noise		0 (-5)	
Flies		0 (-5)	
Tail docking		0 (-5)	
Cleanliness score		5 (-5)	
Milking parlour and waiting area	**2**	**5**	
Behaviour		3 (-3)	
Max. time waiting before entering the milking parlour		2	
Waiting area	**9**	**18**	
Shade		6 (-6)	
Presence of a ventilation system		1	
Presence of sprinklers		5	
Slipperiness floor		2	
Cleanliness floor		2	
Flatness floor		2	
Milking parlour	**9**	**19**	
Placing of feeding troughs		3	
Space		3	
Slipperiness floor		1	

Cleanliness floor		1 (-1)
Flatness floor		1 (-1)
Stairs and slopes		2
Walking related to the placement of the shafts		2
Light		2
It smells nice		1 (-2)
% kicking cows		3 (-3)
Exit milking parlour	**3**	**6**
Floor		1 (-1)
Mud		2 (-2)
Surface		2
Rubbish and obstacles		0 (-2)
Slopes		1
Water	**16**	**33**
Ad libitum water available		10
Type of place to drink		3
Cleanliness		5
Temperature		5
Distance from the pasture with cows to the place to drink		3
Sufficient amount and size of drinking troughs		5
Safety of the drinking trough		2
Feeding sites	**13**	**27**
Additional feeding sites in the pasture		10
Surface		3
Cleanliness of the surface		3
Feeding place per cow		3
Contamination of the feeding site		0 (-3)
Distance from the pasture to the feeding site		3
Quality		5
Walkways	**9**	**18**
Floor		3

Mud		5 (–5)
Surface		3
Rubbish and obstacles		0 (–5)
Walking distance		3
Slopes		2
Speed of cows walking		2
Loading site	**0**	**2**
Steepness		0 (-1)
Safety		1
Flatness floor		1 (-1)
Straight end		0 (-1)
Pastures	**35**	**70**
Shade during hot hours of the day		20 (-20)
Food availability		20 (-20)
Mud		10 (-10)
Rubbish and obstacles		10 (-10)
Presence extra pasture		5
Mud extra pasture		5
Farmer and staff	**35**	**70**
Relevant education farmer		5
Relevant education staff		5
Way of herding		10 (-10)
Way of treating the cows during herding		20 (-15)
Way of treating the cows around the milking parlour		20 (-15)
Use of automatic driving aids		10 (-10)
Environmental management	**5**	**10**
Rest during hot hours of the day		5
Milking hours aligned to the climate		5
Animal health	**100**	**202**
Hair		5 (-10)

% lameness / year and locomotion	25 (-25)
Hocks	20 (-60)
Carpus	20 (-60)
Claws	20
% mastitis /year	15 (-15)
Abomasal dislocation	10 (-15)
Filling of the rumen	5 (-10)
% milk fever /year	5(-10)
Acetonaemia	5 (-15)
Body Condition Score	17
% Rumen acidosis / year	15
Fertility	25 (-10)
Calving	15
Cow mortality	0 (-500)
Total	**500**

Parameters

The environmental related parameters that influence the welfare of cows are discussed below. Indications for the points that can be acquired are explained. Behind the scores is the percentage found during the study. Pictures are added to clarify the different options.
For the results and graphics found during the study see appendix.

GENERAL

Environmental noise

Noise in the environment, produced by tractors, cars, airplanes, shouting etc., is not pleasant for the cows.[16, 17, 25, 48]

• If there is not much noise	→ 0 points	96 %
• If there is some noise	→ -3 points	
• If there is a lot of noise	→ -5 points	4 %

Flies

Flies can be irritating for the cows. Cows that suffer from flies wave their tails to drive the flies away; they hit themselves with their tails, throw their head in the flank or kick their own belly. There are certain fly-control methods to keep the flies away.[10]

• No flies	→ 0 points	0%
• A few	→ -2 points	33%
• Many flies	→ -4 points	56%
• Very many flies	→ -5 points	11%

Pic.1 No flies

Pic.2 A few flies

Pic.3 Many flies

Pic.4 Very many flies

Tail docking

In the United States of America tail docking has become very common.[24] Mostly, this is done for the convenience of stock persons during milking but it is justified as being advantageous for the control of mastitis, leptospirosis and fly numbers.[5] A cow with a docked tail cannot chase the flies away. Tail docking itself is also not pleasant for the cow. Evidence has been found of acute pain associated with docking.[45, 46] Tail docking also causes chronic pain which affects the cows in their welfare.[13]

• Tails not docked	→ 0 points	97%
• Tails docked	→ -5 points	3%

Pic.5 Tails not docked

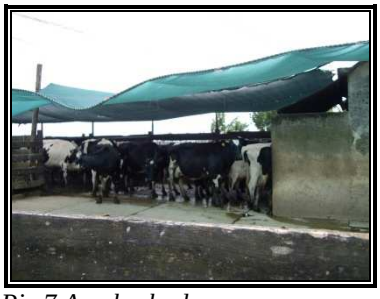
Pic.6 Tails docked

WAITING AREA

Shade

It is important for cows to have access to shade. When it is hot and the cows do not have access to shade they can suffer from heat stress.[37] Heat stress can be significantly reduced if shade is provided.[41, 47]

• If there is ample shade in the waiting area	→ 6 points	38%
• If there is a bit shade in the waiting area	→ 0 points	
• If there is no shade in the waiting area	→ -6 points	62%



Pic.7 Ample shade

Pic.8 A bit shade

Pic.9 No shade

Presence of a ventilation system

A ventilation system ensures cows suffer less from the heat. A fan is an example of a ventilation system. Bucklin et al (1991) found that a fan cooling system in combination with shade can improve cow comfort and increase milk production of cows in hot, humid climates.[8]

• If there is a ventilation system present	→ 1 point	0%
• If there is no ventilation system present	→ 0 points	100%

Presence of sprinklers

Sprinklers spray water, which provides cooling. This prevents suffering from heat stress.[18]

- If there are sprinklers → 5 points 3%
- If there are no sprinklers → 0 points 97%

Pic.10 Sprinklers

Pic.11 No sprinklers

Slipperiness floor

The floor has to provide sufficient grip. Without grip animals can slip or fall down and get injured.

- Sufficient grip present → 2 points 41%
- No sufficient grip present → 0 points 59%

Pic.12 Sufficient grip

Pic.13 No sufficient grip

Cleanliness floor

A lot of dirt can make the floor slippery. Dirt is a good environment for bacteria etc. thus it can affect the health of an animal. For example, if a cow has to stand in the dirt for a while this can cause claw problems. Attention to hygiene can reduce the incidence of lameness.[15, 38]

- A clean floor → 2 points 44%
- A bit dirty floor → 1 point 24%
- A dirty floor → 0 points 32%

Pic.14 Clean

Pic.15 A bit dirty

Pic.16 Dirty

Flatness floor

Holes or lumps in the floor can make a cow fall down or trip. It is also unpleasant if an animal has to stand unequal because the floor is not flat.

• Flat floor	→ 2 points	48%
• Small holes / lumps	→ 1 point	33%
• Big holes / lumps	→ 0 points	19%

Pic.17 Flat floor

Pic.18 Small holes

Pic.19 Big holes

MILKING PARLOUR

Placing of feeding troughs

Feeding troughs need to be placed in a way that the cow can keep her head in a natural position during eating. If the feeding trough is not placed straight in front of the cow she has to keep her head skewed which is very uncomfortable.

• Straight in front of the head	→ 3 points	76%
• Oblique in front of the head	→ 0 points	24%

Pic.20 Straight

Pic.21 Oblique

Space

A cow does not have enough space when she cannot stand straight, when she has to bend her head to fit in or when a bar is pushing against her body. This is very uncomfortable and makes the cow dislike milking.

• If the cow has enough space	→ 3 points	32%
• If the cow doesn't have enough space	→ 0 points	68%

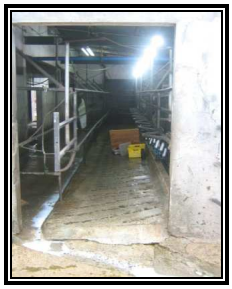
Pic.22 Enough space

Pic.23 Not enough space

Slipperiness floor

The floor has to provide sufficient grip. Without grip animals can slip or fall down and get injured.

• Sufficient grip present	→ 1 point	33%
• No sufficient grip present	→ 0 points	67%




Pic.24 Sufficient grip *Pic.25 No sufficient grip*

Cleanliness floor

A lot of dirt can make the floor slippery. Dirt is a good environment for bacteria etc. thus it can affect the health of an animal. For example if a cow has to stand in the dirt for a while this can cause claw problems. Attention to hygiene can reduce the incidence of lameness.[15, 37]

• A clean floor	→ 1 point	61%
• A bit dirty floor	→ 0 points	31%
• A dirty floor	→ -1 point	8%



Pic.26 Clean *Pic.27 A bit dirty* *Pic.28 Dirty*

Flatness floor

Holes or lumps in the floor can make a cow fall down or trip. It is also unpleasant if an animal has to stand unequal because the floor is not flat.

• Flat floor	→ 1 point	45%
• Small holes / lumps	→ 0 points	52%
• Big holes / lumps	→ -1 point	3%

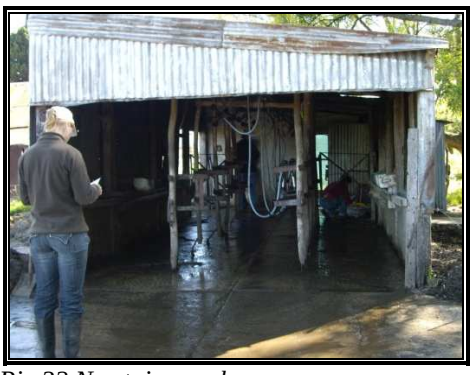


Pic.29 Flat *Pic.30 Small holes* *Pic.31 Big holes*

Stairs and slopes

Stairs and slopes constitute a problem for the cow. They can be an obstacle for the animals where they can slip or fall down. Especially when the stairs or slopes get wet it can be dangerous. Animals walk very slowly and act reluctant when passing a slope. They look very scared and try to avoid it.

• No stairs or slopes present	→ 2 points	53%
• Stairs or slopes present	→ 0 points	47%



Pic.32 No stairs or slopes

Pic.33 A slope

Light

The light in the parlour is sufficient when it is possible to read a newspaper anywhere in the barn.

• If there is sufficient light in the barn	→ 2 points	52%
• If there is not enough light in the barn	→ 0 points	48%

Pic.34 Sufficient light

Pic.35 No sufficient light

It smells fresh

The air quality is measured by the smell. It should not smell like gases (NH3, H2S or other gases).

• If it smells fresh	→ 1 point	20%
• If it smells like gases	→ 0 points	80%
• If it smells very strong	→ -2 points	0%

EXIT MILKING PARLOUR

Floor

Cows prefer a soft floor. A hard floor, like concrete, ensures that the claws wear faster. That is why a floor of grass gets most points assigned. A floor that is made of sand can get holes in it very easily, especially when a lot of cows walk on it a few times a day.

• Grass	→ 1 point	0%
• Concrete	→ 0 points	60%
• Sand	→ -1 point	40%

Pic.36 Concrete

Pic.37 Sand

Mud

A lot of mud can make the floor slippery. Mud is a good environment for bacteria which can affect the health of an animal. Besides this, it makes a claw wet and this can decrease the hardness of the claw. Cows with softer claws are at greater risk for lameness.[7]

• No mud	→ 2 points	40%
• A little bit of mud	→ 0 points	20%
• Ample mud	→ -2 points	40%

Pic.38 No mud

Pic.39 A bit of mud

Pic.40 Ample mud

Surface

It is very uncomfortable and can be dangerous if the surface is severely convex or has a lot of holes. If the surface is convex all the cows are walking in a line in the middle or on the sides. The middle and sides are a little bit flat and the rest is not.

• A flat surface	→ 2 points	50%
• A convex surface	→ 1 point	20%
• Severely convex surface	→ 0 points	0%
• Holes in the floor	→ 0 points	30%

Fig.1 Flat

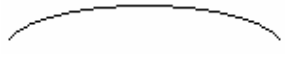


Fig.2 Convex

Fig.3 Severely convex

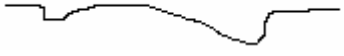


Fig.4 Holes

Rubbish and obstacles

Rubbish and obstacles are annoying for the cows. They have to walk around it and if they accidentally step on it they can get injured.

- No rubbish or obstacles → 0 points 60%
- A little bit of rubbish or obstacles → -1 point 20%
- Lots of rubbish or obstacles → -2 points 20%

Pic.41 No rubbish

Pic.42 A little bit of rubbish

Pic.43 A lot obstacles

Slopes

A slope is an obstacle for the animals where they can slip or fall down. Especially when the slope is wet it can be dangerous. Animals walk very slowly and act reluctant. They look very scared and try to avoid the obstacle.

- No slopes present → 1 point 60%
- Slopes present → 0 points 40%

Pic.44 No slope

Pic.45A slope

WALKWAYS

Floor

Cows prefer a soft floor. A hard floor, like concrete, ensures that the claws wear faster. That is why a floor of grass gets most points assigned. A floor that is made of sand can get holes in it very easily, especially when a lot of cows walk on it a few times a day. .

- Grass → 3 points 21%
- Concrete → 1 point 4%
- Sand → 0 points 75%

Pic.46 Grass

Pic.47 Sand

Mud

A lot of mud can make the floor slippery. Mud is a good environment for bacteria which can affect the health of an animal. Besides it makes a claw wet and this can decrease the hardness of the claw. Cows with softer claws are at greater risk for lameness.[7]

• No mud	→ 5 points	18%
• A little bit of mud	→ 0 points	32%
• Ample mud	→ -5 points	50%

Pic.48 No mud

Pic.49 A bit of mud

Pic.50 Ample mud

Surface

It is very uncomfortable and can be dangerous if the surface is severely convex or has a lot of holes. If the surface is convex all the cows are walking in a line in the middle or on the sides. The middle and sides are a little bit flat and the rest is not. A poor quality of the surface contributes to the incidence of lameness in pasture-based systems.[2, 3, 50] The incidence of lameness can be considerably reduced by paying attention to walking surfaces and maintain them carefully.[14, 38]

• A flat surface	→ 3 points	50%
• A convex surface	→ 1 point	11%
• Severely convex surface	→ 0 points	3%
• Holes in the floor	→ 0 points	36%

Pic.51Flat

Pic.52 Convex

Pic.53 Severely convex

Pic.54 Holes

Fig.1 Flat

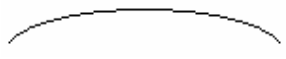


Fig.2 Convex

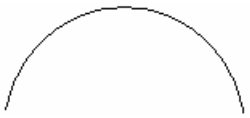


Fig.3 Severely convex

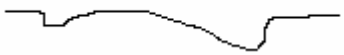


Fig.4 Holes

Rubbish and obstacles

Rubbish and obstacles are annoying for cows. They have to walk around it and if they accidentally step on it they can get injured.

• No rubbish or obstacles	→ 0 points	36%
• A little bit of rubbish or obstacles	→ -3 points	52%
• Lots of rubbish or obstacles	→ -5 points	12%

Pic.55 No rubbish/obstacles

Pic.56 A bit of rubbish

Pic.57 A lot obstacles

Walking distance

It costs a lot of energy for an animal to walk very far, especially when the walkway is in bad condition. Loss of energy affects the milk production. A long walking distance also contributes to the incidence of lameness in pasture-based systems.[2, 3, 50]

The walking distance (from the meadow to the milking parlour) can be measured with a telemeter.

• < 1 km.	→ 3 points	61%
• 1 – 3 km.	→ 1 point	31%
• > 3 km.	→ 0 points	8%

Slopes

Slopes can be an obstacle for the animals; they can slip or fall down. Especially when the slope is wet it can be dangerous. In this situation animals walk very slowly and act reluctant when passing a slope. They look scared and try to avoid it.

• No slopes present	→ 2 points	57%
• Slopes present	→ 0 points	43%

Pic.58 No slopes

Pic.59 Slopes

Speed of cows walking

Cows can walk faster on a walkway that is in good condition. When a walkway is full of rubbish, obstacles and holes they will walk slowly. The investigator has to walk along with the cows and use a speedometer to measure the speed.

• > 4 km. p/h	→ 2 points	86%
• 3 – 4 km. p/h	→ 1 point	14%
• < 3 km. p/h	→ 0 points	0%

LOADING SITE

Steepness

It is uncomfortable for cows to walk on a steep slope. Less steep is better for animals because excessively steep ramps may injure animals.[16] In general; the loading sites are equally steep because they are aligned to the same sort of transport trucks. However a loading site can be less steep if the place for the truck is lower than the place where cows enter the loading site. The slope is expressed in degrees.

• 0 – 15 degrees	→ 0 points	12%
• > 15 degrees	→ -1 point	88%

Pic.60 0 – 15 degrees

Pic.61 > 15 degrees

Safety

A loading site is not safe when it contains sharp edges, protruding screws etc. A cow can get injured when walking on a loading site that is not safe.

• Loading site is safe	→ 1 point	71%
• Loading site is not safe	→ 0 points	29%

Pic.62 Safe

Pic.63 Not safe

Flatness floor

Holes or lumps in the floor can make a cow fall down or trip. It is also unpleasant if an animal has to stand unequal because the floor is not flat.

• Flat floor	→ 1 point	100%
• Small holes / lumps	→ 0 points	0 %
• Big holes / lumps	→ -1 point	0%


Pic.64 Flat floor


Pic.65 Small lumps


Pic.66 Big holes/lumps

Straight end

A straight end of the loading site is comfortable for cows. This makes the transition between loading site and transport truck better passable for cows.

• If the loading site ends straight	→ 0 points	14%
• If the loading site doesn't end straight	→ -1 point	86%


Pic.67 Straight end


Pic.68 No straight end

PASTURES

Shade during hot hours of the day

It is important that cows have the opportunity to get into the shade during the hottest hours of the day. Otherwise they may suffer from heat stress. It is best to have as many places with shade as possible.

• > 80% of the cows has a place in the shade	→ 20 points
• 60-80% of the cows have a place in the shade	→ 10 points
• 40-60% of the cows have a place in the shade	→ 0 points
• 30-40% of the cows have a place in the shade	→ -10 points
• < 30% of the cows has a place in the shade	→ -20 points


Pic.69 > 80% has a place in the shade


Pic.70 < 30% has a place in the shade

Food availability

Food availability is important for animals. If there is enough grass all the cows can eat and express natural behaviour such as grazing and exploration. If there is just a bit of grass this might be not enough for all the cows to eat and express natural behaviour.

- Pasture full of grass → 20 points
- Pasture with a lot of grass → 10 points
- Pasture with some grass → 0 points
- Pasture with (almost) no grass → -20 points

Pic.71 Full of grass

Pic.72 A lot of grass

Pic.73 Some grass

Pic.74 Almost no grass

Mud

A pasture with a lot of mud can decrease the welfare of a cow. Mud (and feces) can be a good environment for bacteria which can affect the health of animal. Besides it makes a claw wet and this can decrease the hardness of the claw. Cows with softer claws are at greater risk for lameness.[7]

- Clean → 10 points
- Mud / faeces → 0 points
- Lots of mud / faeces → -10 points

Pic.75 Clean

Pic.76 Mud/feces

Pic.77 Lots of mud / feces

Rubbish and obstacles

Rubbish and obstacles are annoying for the cows. They have to walk around it and if they accidentally step on it they can get injured.

- No rubbish or obstacles → 10 points
- A little bit of rubbish or obstacles → 0 points
- Lots of rubbish or obstacles → -10 points

Pic.78 No rubbish or obstacles

Pic.79 A bit of rubbish

Pic.79 Lots of obstacles

Presence extra pasture

An extra pasture is used with excessive climates such as massive rainfall or extreme dryness. The extra pasture is near the milking parlour so the cows do not have to cover a large distance. The other pastures and walkways will retain in good condition.

- Extra pasture present → 5 points 40%
- No extra pasture present → 0 points 60%

Mud extra pasture

A pasture with a lot of mud can decrease the welfare of a cow. Mud (and faeces) can be a good environment for bacteria which can affect the health of animal. Besides it makes a claw wet and this can decrease the hardness of the claw. Cows with softer claws are at greater risk for lameness.[7]

- Clean → 5 points 50%
- Mud / faeces → 2 points 50%
- Lots of mud / faeces → 0 points 0%

FARMER AND STAFF

Relevant education farmer

A relevant education gives the farmer more view about keeping and handling cows. This benefits the well-being of the cows. Grandin (1989) says: "An understanding of the behaviour of livestock will facilitate handling, reduce stress, and improve both handler safety and animal welfare." [16]

- He has a relevant education → 5 points 67%
- He does not have a relevant education → 0 points 33%

Relevant education staff

A relevant education gives the staff more view about keeping and handling cows. This benefits the well-being of the cows. According to Grandin (1989) handlers who understand livestock behaviour can reduce stress. "An understanding of the behaviour of livestock will facilitate handling, reduce stress, and improve both handler safety and animal welfare."[16]

- They have a relevant education → 5 points 0%
- They do not have a relevant education → 0 points 100%

Way of herding

Herding by foot is much quieter than by horse or motorbike. A horse or motorbike goes fast so the cows will be chased. A motorbike produces also a lot of noise and cows do not like noise.

If someone is walking behind the animals to take them to the waiting room the cows can walk at their own pace. When a person on a horse or motorbike is herding, cows try to walk as fast as they can. Because of this they can trip, bump in to each other or get injured. They get anxious and panic a bit trying to walk as fast as possible.

Best is to move cattle at a slow walk. Fearful animals are more likely to balk and are more difficult to handle. Handlers should move slowly and deliberately. Sudden jerky motions frighten the animals. In the wild, sudden movements are associated with predators.[17]

• By foot	→ 10 points	55%
• By horse	→ 0 points	45%
• By motorbike	→ -10 points	0%

Pic.80 By foot

Pic.81 By horse

Way of treating the cows during herding

Acting quiet during herding is the best way to keep the cows calm. Cows do not like noise and thus they do not like whistling or yelling. Shouting at cows works aversive.[31] Beating them or using an object (for example a stick) is even worse. This hurts the cows and makes them anxious and scared. Poor herding skills contribute to the incidence of lameness in pasture-based systems.[2, 3, 50]

It is possible that multiple options can be applied. If that is the case, points are added together.

• Quiet	→ 20 points	38%
• Whistling	→ 0 points	22%
• Yelling	→ -5 points	25%
• Beating (hitting / kicking)	→ -15 points	9%
• Using an object	→ -15 points	6%

Pic.82 Using an object

Way of treating the cows around the milking parlour

Acting quiet during herding and milking is the best way to keep the cows calm. Cows do not like noise and thus they do not like whistling or yelling. Shouting at cows works aversive.[31] Beating them or using an object (for example a stick) is even worse. This hurts cows and makes them anxious and scared. This way they will get aversion for the milking process and next time it is even more difficult to get them in the milking parlour.

It is possible that multiple options can be applied. If that is the case, points are added together.

• Quiet	→ 20 points	49%
• Whistling	→ 0 points	11%
• Yelling	→ -5 points	17%
• Beating (hitting / kicking)	→ -15 points	17%
• Using an object	→ -15 points	6%

Use of automatic driving aids

The use of automatic driving aids (for example electrical prods or a backing fence) forces the cows in the direction of the milking parlour. This is easy for the farmer but cows do not like forced traffic. It alters milk quality and eating behaviour.[4] Electric prods, restraint and other handling stressors will also lower female reproductive function.[21, 43, 44]

• No	→ 10 points	100%
• Yes	→ 0 points	0%
• With electricity	→ -10 points	0%

Validation
The scoring system was validated by assessing several farms. These farms were scored using the scoring system for pasture-based dairy cows. Also a ranking was made based on a general impression of the investigators and veterinarian who visited all the farms. If the ranking matches with the scores this indicates that the scores are assigned right.

At some farms there was no loading site present. In the category 'loading site' these farms get half the maximum points assigned.
For some categories a single parameter could not be scored. All the farms of the validation did not get a score assigned for this parameter. In the categories where this was the case, de minimum score was adapted.
A parameter with a maximum of 3 points has 1 point deduction in the minimum score.
A parameter with a maximum of 5 points has 2 points deduction in the minimum score.
A parameter with a maximum of 20 points has 7 points deduction in the minimum score.
For the scoring systems of the farms see appendix.

Farms 1-9

Ranking	*Scores*
1. Farm 4	1. Farm 4 – 347 points
2. Farm 1	2. Farm 1 – 340 points
3. Farm 3	3. Farm 3 – 270 points
Farm 2	4. Farm 9 – 235 points
5. Farm 7	5. Farm 5 – 229 points
6. Farm 9	6. Farm 2 – 199 points
7. Farm 5	7. Farm 6 – 191 points
8. Farm 6	8. Farm 7 – 172 points
9. Farm 8	9. Farm 8 – 120 points

Farms 4, 1, 3 and 8 have the same position in ranking and scores.
Farm 2 and 3 share a third place in ranking, while farm 2 has a lower position in scores. This deviation is mainly caused by the categories 'general' and 'animal health'. Farm 2 scores very bad in these categories in comparison to the other farms. Farm 3 has an average or high score in these categories.
Farm 7 has a higher position in ranking than in scores. In most categories it has average or low scores. In the category 'farmer and staff' there is a large deviation in scores in comparison to other farms, which is the main cause of the low position in scores. It scores -48 points while the average score is 20 points.
In scores farm 5 and 9 have a higher position than in ranking. This might be caused by a shift of farm 2 and 7. These farms moved from a higher position in ranking to a lower position in scores.
Farm 6 has position 8 in ranking and position 7 in scores. This is just a small deviation, which is caused by the displacement in scores of farm 7.

Overall the ranking matches with the scores ($r = 0.8$; $p < 0.05$). Most deviations are caused by the difference in ranking and scores of farm 2 and 7. This difference may possibly be caused by the judgment of the investigators or scores that are not valid. The other seven farms have the same position in ranking and scores compared to each other.

Comparison with the barn-based scoring system

General
The general parameters can be used in both scoring systems. In this system, 2 parameters are added because they are very important for the welfare of pasture-based dairy cows. These parameters are 'broken tails and tail docking'. Broken tails are not common in the Netherlands but in Uruguay it has often been seen. This category has the same amount of points in both systems.

Waiting area and milking parlour
In this system there are much more parameters in the categories waiting room and milking parlour. In a pasture system it is possible that the cows have to stand in the waiting area for a few hours. Most of these waiting areas are outdoors and there is no shade. When it is very hot outside the cows could suffer from heat stress. Therefore the parameter 'shade' is included. It is also important for cows to be comfortable during milking. If they are uncomfortable during milking or have some bad experiences they will get aversion for the milking parlour. 'Space' and 'walking related to the placement of the shafts' are parameters that score the comfort of the cow in the milking parlour.
In the barn-based system 120 points are assigned to the parameters of the categories light, ventilation and floor. In the pasture-based system these parameters are included in the categories 'waiting area, milking parlour and exit'. These categories have got much less points assigned (43 points), because the cows are in the pasture most of the day, while the cows in the barn-based system are in the barn all day.

Exit milking parlour
Some horrible exits were seen during this study. It is important to have a good exit because a bad one can do harm to the cows. This can affect their welfare. Important parameters to look at are mud and obstacles. In the barn-based system the exit is not included in the system.

Water
Some parameters are added to this category. Therefore it has got 33 points assigned in the pasture-based system. While in the barn-based system it has got 25 points assigned. Animals that live in the barn almost always have access to water. They do not have to walk very far to reach a drinking place. In Uruguay, the cows can be in different pastures. Not all the pastures have drinking places and sometimes the cows have to walk very far to drink water. Sometimes the drinking places are unsafe and a cow can fall into the water. This could hurt them or they could even drown.

Feeding places
This category has 12 points more than the category 'feeding fence' in the barn- based system, because a few parameters are added, like the distance to the feeding troughs. In the barn the cows do not have to walk far to get food. A cow that lives on pasture sometimes has to walk a long distance to reach a feeding trough. The feeding troughs are mostly in the milking parlour or outside next to it. Some farms have pastures which are several kilometres away from the milking parlour.

Walkways
In the barn-based system there are a few parameters about the walkways. These are different than the walkways in the pasture-based system because these walkways are outdoors. The parameters about walkways in the barn are mostly about the width. While the parameters in

this system are about surface, obstacles, mud and distance. The weight of the quality of the walkways is more important in the pasture-based system because cows have to walk substantially more. In the barn-based system there are 5 points assigned, while in the pasture-based system 18 points are assigned.

Loading site
The loading site is a category with four parameters. This category is not used in the barn-based system. Some very bad loading sites were seen during this study. These loading sites could injure the cows. The loading site is a place the cows see once in their life, that is why it does not get much points addressed. Important things to look at are steepness, safety, flatness of the floor and a straight end.

Pastures
The category 'cubicles' in the barn-based system has been replaced by the category 'pastures'. Both categories have the same amount of points (70 points). Parameters which are scored are the floor of pastures, mud, the surface, rubbish, walking distance, drainage, the presence of an extra pasture and the cleanliness. Pastures are very important for cows that live on pastures all year long. An extra pasture is used with massive rainfall or during dryness. Cows which live on pastures can benefit from an extra pasture. Cows which live in the barn do not need something like that.

Farmer and staff
Parameters about the farmer and staff are not used in the barn-based system. Rousing et al. (2004) found that stockman activities need to be properly managed; else it can produce fear, anxiety and pain. Fear for the milker can afterwards cause cows to be unpleasantly affected by milking and this constitutes a great welfare problem in dairy cattle herds (as seen above in 'waiting area and milking parlour'). This means behaviour of farmer and staff can importantly influence the welfare of cows.[35] For this reason the category 'farmer and staff' is placed in the pasture-based scoring system and has got 70 points assigned.
The most important parameters are the way of treating cows during herding and around the milking parlour.

Environmental management
Environmental management is very important for cows that live outdoor. It is pleasant for cows to be able to rest during the hottest period of the day instead of walking to the milking parlour and standing in the sun (in the waiting area) for hours. This category is not included in the barn-based system.

Animal health
Animal health is very important for the well-being of cattle, regardless of living on pasture or in the barn.[39] The maximum score for this category is 202 points. Parameters like hair, lameness and mastitis are included in the systems. The biggest problems in Uruguay seem to be lameness and mastitis.

Some categories that were used in the barn-based system and not in this system are 'cubicles/free stalls', 'feeding fence' and 'miscellaneous'. These categories were not included because they are not applied for cows living on pasture; therefore it is not possible and relevant scoring these parameters.

Comparison between cows that live in the barn or on pasture

A public opinion is that cows on pasture are happier and have better welfare than cows living in a barn. One of the greatest concerns is the unnaturalness of modern housing conditions. Spinka (2006) thinks this approach is naïve because some natural conditions cannot be good for animals, such as exposure to climatic extremes, parasite infections and disease.[42] It is even difficult to decide what natural life is, because a lot of genetic changes have occurred due to artificial selection.[36]

Lameness
Instinctively, it seems cows on pasture have higher welfare and will have less lameness than cows in the barn. Olmos et al (2009) found that a pasture system reduces the risk of lameness compared to an indoor system.[29] It also appeared that uncomfortable stalls and zero grazing are important risk factors for the incidence of lameness.[9] If a lame cow is provided access to pasture she will improve more rapidly than without access to pasture.[20]
This implies that cows on pasture have some benefits since they will recover faster and suffer less from lameness in comparison to housed cows. This is only the case when pasture and walkways are in good condition. For example, when tracks are poorly maintained, the incidence of lameness can also be high in pasture-based dairying systems.[26]

Milk yield
An important question is: Do cows that live on pasture produce more milk? This is a complicated question, since there are many factors that influence milk yield. It is therefore important to notice that it is not easy to relate welfare to milk production. It can be affected by nutritional, genetic, and environmental factors that are welfare neutral.[24] Therefore, a high level of milk production does not mean high welfare and a low level does not mean poor welfare.[24]
Furthermore, a high production level seems good but might increase the risk of certain welfare problems, and it is associated with an increased risk of health problems.[33]

Natural behaviour
Nowadays stocking rates are much higher in the barn than in traditional grazing situations. It is normal that there can be aggressive interactions on pasture, but in the barn this is much more common, especially when there is an overcrowded situation.[30, 32]
One of the big differences between cows in the barn and on pasture is that cows on pasture can express natural feeding behaviour such as grazing and exploration. Cows that are able to express this behaviour have reduced hunger and they are sometimes perceived as having higher welfare.[19, 24]
It is difficult to find out what a cow prefers; the barn or pasture. In a recent study cows were able to choose for themselves. Cows that live in a well-designed and managed free-stall barn had free-choice access to a pasture next to the barn. They could go to the pasture every time they wanted to. Notable was that cows preferred the pasture at night but during daylight they returned to the barn, especially with high temperatures. The pasture did not provide any shade. Probably the cows prefer pasture but when it is hot they choose shade over pasture and thus go into the barn.[27]

Discussion

There is no cow-comfort scoring system for pasture-based dairy cows. This means in this study the system was designed from scratch and there was nothing to compare with. The barn-based scoring system was used as basis, since the pasture-based scoring system had to be similar.
The pasture-based scoring system is only usable in pasture-based dairy systems.

In the barn-based system negative scores weigh more than positive ones, which is unique for that system.[12] The pasture-based system is similar to the barn-based system, the negative scores also weigh more than positive ones.
A parameter that is negatively scored indicates that this parameter is necessary for the welfare. A hungry cow does not care about having shade in the waiting area or having enough light in the milking parlour. A hungry cow only wants food. While a cow with a broken leg does not care about having food (shade or light). She only wants to get rid of the pain of her broken leg. This shows the relative importance of the different parameters. At one moment food can be very important, while in another situation it is much less important. For this reason a minimum score needs to be obtained for each category. When this score is not obtained, a number of points is subtracted from the total amount of points. This way the importance of the parameter is increased for the total score.

The percentages of the parameters found during the study could give a distorted view. Some parameters were included later in the system and scored only a few times (or not scored at all). The percentages are based on relatively little data and therefore not significant.

The validation of the system is very difficult. It is done by making a ranking and see if the ranking matches with the scores. The ranking is subjective because it is based on a general impression of the investigators and veterinarian. Therefore a difference between the ranking and the scores does not always mean the assigned scores are not valid.

An attempt was made to keep the scoring system objective. Some influences make it impossible for the system to be entirely objective.
Some parameters are divided in several options. The option chosen is the choice of the investigator. He or she has very good guidelines to make an informed choice. However it is possible that in some situations various investigators will not always choose the same option. To avoid this, the scoring was always done by 2 investigators who are provided with a comprehensive description and pictures about the several options.
The scoring can also be influenced by the farmers. They have to answer some questions about the health of the animals. Most of the farmers in Uruguay do not keep data. The data they give are based on their memory. It is impossible to remember all the health issues the cows had over the last year. This means that some parameters get a score assigned based on the farmers answers. These answers will not always match reality. To constrain this, farmers are asked about the health issues that day and over the last year.

A substantial number of farms were visited during this study. The veterinarian (the investigators went along with) is a mastitis expert. This implies that most of the visited farms had problems with mastitis among the cows. A huge mastitis problem can arise because of problems with hygiene in the milking parlour or because the cows are standing in the mud. These problems might also be a signal of bad welfare for cows. On one hand these farms are useful to visit because it becomes clear which parameters are important for the welfare of

cows. On the other hand it is also good to see the contrary; farms without these health-related problems. This can give a view about how the welfare of cows can be improved and what a 'happy cow' looks like.

One of the five freedoms is 'being free from thirst, hunger and malnutrition. Food is very important for an animal.[1] It is very complicated to include all factors that have something to do with food. For example, the quality of food is rated, but there is no rating of the grass. Grass varies in amount of carbohydrates and fibre. To get to know more about this a grass sample should be taken from every pasture on the farms that are visited and the percentages should be rated. Dry matter intakes can be variable and/or sub-optimal at pasture as they are closely linked to the quality of grass and to environmental conditions.[2, 3, 50]
One of the goals of this system is to find a relation between the comfort-score and the milk production. A veterinarian from Uruguay experiences a big difference between food, comfort and milk production on farms. Some farmers use the help of a nutritional expert who makes sure the amount, sort and quality of food are good. On these farms it sometimes seems the comfort-score would be low but the milk production is high. Other farms sometimes do not pay much attention to the food and have a high comfort-score but the milk production is low. This indicates nutrition plays a key role.[28] According to Arkins (1981) and Westwood (2003) there can be an imbalance between energy provision and the energy cows need for maintenance and milk production.[2, 3, 50]
Van Eerdenburg et al (2009) found a correlation between milk production and cow-comfort score under barn-based conditions in the Netherlands.[12] Based on the study that is done in Uruguay it is not likely that a relation between milk production and the cow-comfort score will be found in Uruguay, because the differences in (kind and quality of) food on pasture based farms (in Uruguay) are too big. It might be possible to find a similar relation in Uruguay but more farms need to be visited to eliminate the differences in food.

Conclusion

The aim ‘to set up a scoring system for pasture-based dairy cows and make a comparison with the barn based scoring system’ has been accomplished. The system has been developed and the validation showed positive results. Further research will show if the system can also be used on its own or only in comparison with the barn-based system from van Eerdenburg et al.[12]

‘Are cows that live on pasture happier than cows that live in a barn?’ This question is still not answered. Cows that live on pasture have a lower risk for lameness. When given the choice cows prefer pasture over barn, but only when the pasture is well-maintained and provides shade. However, pasture cows also suffer from exposure to climate extremes, parasite infections and disease.

More research needs to be done to improve and fine tune the scoring system and to find out whether a cow is happier when she lives on pasture or not.

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Appendix 1: The barn-based scoring system

Table 2. The barn-based scoring system for dairy cows

	Minimum	Maximum	points
General	**10**	**20**	
- Fear behaviour		5	
- Stretching when raising from cubicle		3	
- Tail is hanging straight and relaxed		3	
- Bellowing		4	
- Number of cows standing idle		0 (-100)	
- Cows sleeping in walk ways		5 (- 10)	
- Noise (environmental)		0 (-5)	
Light	**5**	**25**	
- Sufficient light in the barn		10	
- Period of light > 15 hr		5	
- Period of dark > 6 hr		10	
Ventilation	**30**	**50**	
- It smells fresh (between the animals)		5	
- Cobwebs		10	
- Condense / mold		10	
- Barn temperature		10	
- Dead spaces		5	
- Draft		10	
Cubicles / Free stalls	**40**	**70**	
- Cows are clean		5	
- Bedding is made of inorganic material		5	
- Bedding is soft		10 (-10)	
- Bedding is clean and dry		10	
- Stall surface is under a slight angle		5	
- Bedding is flat		5 (-5)	
- Neck rail		5	
- Lunge space		10	
- Length / width of the stall		10	
- Brisket board		5	
- Number		0 (-10)	

Floor	***20***	***45***	
- Slipperiness		10	
- Loose / unequal slats		10	

- Rubber		10	
- Walking		10	
- Cleanliness		5	
Feeding fence	**6**	**15**	
- Headlocks		5	
- Height		3	
- Number of places		7	
- Contamination		(-3)	
Water	**15**	**25**	
- Number of places		10	
- Type of waterer		5	
- Cleanliness		5	
- Temperature		5	
Waiting room and milking parlor	**2**	**5**	
Behaviour		3	
Time		2	
Walkways and alleys	**3**	**5**	
Width of the alley behind the feeding fence		2 (-2)	
Width other walkways		2	
Sufficient passages		1	
Miscellaneous	**10**	**40**	
Maternity pen		3	
Sick bay		2	
Access to pasture / outside paddock		20	
Is there a mechanical brush?		15	
Animal (health + feeding)	***100***	***200***	
- Hair		5	
- Lameness		25 (-25)	
- Hocks		20 (-60)	
- Carpus		20 (-60)	
- Claws		20	
- Mastitis		15 (-15)	
- Abomasal dislocation		10 (-15)	
- Filling of the rumen		5 (-10)	
- Milking fever		5 (-10)	
- Acetonaemia		5 (-15)	

- BCS		15	
- Fat %		15	
- Fertility		25 (-10)	
- Calving		15	

Appendix 2: The questionnaire

General information / *Información general*

Date of visit:
Fecha visita:

Number farm:
Matrícula:

Number of dairy cows:
No. de vacas lecheras:

Race:
Raza:

Average age dairy cows:
Edad promedia de las vacas lecheras:

Size area (ha):
Tamaño en ha:

(Animal)health / *Sanidad*

How many cows are you treating today for mastitis?
Cuántas vacas reciben tratamiento por mastitis clínica hoy?

How many cases (%) of mastitis did you have this year? (in case of 14 days healthy and then again mastitis counts as a new case)
Cuántos casos de mastitis clínica hubo durante el año pasado? (la definición de un caso nuevo es: luego de 14 días sin problemas)

How many cows are crippled at the moment?*Cuántas vacas rengas hay hoy?*

What is the percentage cows that were suffering from lameness this year? (Don't count repeated cases twice)
Qué porcentaje de las vacas estuvieron rengas durante el año pasado? (no contar vacas repetidoras)

What is the percentage of cows with milk fever per year?
Anualmente, cuál es el porcentaje de hipocalcemia?

What is the percentage of cows with rumen acidosis at the moment?
Qué porcentaje de las vacas ha sufrido acidosis en algún momento?

What is the percentage of cows that is directly

pregnant after the first insemination?
Cuál es el porcentaje de preñez a la primera inseminación?

What is the average time between calving?
Cuál es el intervalo entre partos?

What is the percentage of cows that get pregnant after insemination?
Cuál es el porcentaje de preñez final?

How many cases (%) needed assistence of a veterinarian at calving?
Cuántas vacas necesitaron asistencia veterinaria durante el parto durante el año pasado?

Miscellaneous / *Misceláneo*

How many times per day are the cows fed?
Con qué frecuencia se suministra el alimento (1 o 2 veces/día)?

How do you estimate the quality of the nutrition?
Cuál es su evaluación de la calidad del alimento? (bien / mal)

Are the cows resting during the hot hours of the day?
Las vacas pueden descansar durante las horas de mayor calor?

Is there ad libitum water available for the cows?
Las vacas tienen acceso a agua fresca y limpia todo el día?

What are the milking hours?
Cuáles son los horarios de ordeño?

How long are the cows maximal waiting in the waiting area?
Cuál es el tiempo que el lote más grande pasa en el corral de espera?

Appendix 3: The score sheet

Score sheet for pasture-based dairy cows	

GENERAL	
* fear behaviour	curious / not fearful / fearful
* stretching when raising from the pasture	yes / no
* tail is hanging straight and relaxed	> 90% / 80-90% / < 80%
* broken tails	… %
* bellowing	< 2x / 2 x / > 2 x
* environmental noise	quiet / some noise / much noise
* flies	no / a few / many / very many
* tail docking	tails not docked / docked tails
* cleanliness score	1:.....2:.....
	3:.....4:.....
	5:.....

MILKING PARLOUR AND WAITING AREA	
* behaviour	waiting in front / waiting in the back
	/ turning their backs to the milking parlour
* max. time waiting before entering the milking parlour	< 1h / 1-2h / > 2h
waiting area	
* shade	a lot / a bit / no shadow
* presence of a ventilation system	yes / no
* presence of sprinklers	yes / no
* slipperyness floor	sufficient grip / no sufficient grip
* cleanliness floor	clean / a bit dirty / dirty
* flatness floor	flat / small holes or lumps / big holes of lumps

milking parlour	
* placing of feeding troughs	straight in front / oblique in front
* space	enough / not enough
* slipperiness floor	sufficient grip / no sufficient grip
* cleanliness floor	clean / a bit dirty / dirty
* flatness floor	flat / small holes or lumps / big holes of lumps
* stairs and slopes	yes / no
* walking related to placement of the shafts	lofty, good / careful, slow
* light	sufficient / not enough light
* it smells nice	fresh / like gasses / strong smell
* % kicking cows	0-5% / 5-10% / 10-15% / 15-20% / >20%

Exit milking parlour	
* floor	concrete / grass / sand
* mud	no / a little / a lot
* surface	flat / convex / severly convex or holes
* rubbish and obstacles	no / a little / a lot
* slopes	yes / no

ENVIRONMENT	
Water	
* ad libitum water available	yes / pastures and waiting area / no

* type of place to drink	natural / constructed
* cleanliness	clean / a bit dirty / dirty
* temperature	cold / warm / hot
* distance from pasture with cows to the place to drink	< 500 m / 500-1500 m / > 1500 m
* sufficient amount and size of drinking troughs	sufficient / not sufficient
* safety of the drinking trough	safe / dangerous

Feeding sites	
* additional feeding sites in the pasture	yes / no
* surface	concrete / grass / sand
* cleanliness of the surface	clean / small layer mud / big layer mud
* feeding place per cow	< 0,9 / 0,9-1,0 / 1,0
* contamination of the feeding site	no contamination / contamination
* distance from the pasture to the feeding place	< 1 km / 1-3 km / > 3 km
* quality	good / bad

Walkways	
* floor	concrete / grass / sand
* mud	no / a little / a lot
* surface	flat / convex / severly convex or holes
* rubbish and obstacles	no / a little / a lot
* walking distance	< 1 km / 1-3 km / > 3 km
* slopes	yes / no
* speed of cows walking	3 km/h / 3-4 km/h / > 4 km/h

Loading place	
* steepness	steep / very steep
* safety	safe / dangerous
* flatness floor	flat / small holes or lumps / big holes of lumps
* straight end	yes / no

Pastures	
* shade during hot hours of the day	>80% / 60-80% / 40-60% / 20-40% / <20%
* food availability	full of grass / a lot / some / almost no grass
* mud	no / a little / a lot
* rubbish and obstacles	no / a little / a lot
* presence extra pasture	yes / no
* mud extra pasture	no / a little / a lot

Farmer and staff	
* relevant education farmer	relevant education / no relevant education
* relevant education staff	relevant education / no relevant education
* way of herding	by foot / by horse / by motor
* way of treating the cows during herding	quiet / whisteling / yelling / beating /
	using an object
* way of treating the cows around the milking parlour	quiet / whisteling / yelling / beating /
	using an object
* use of automatic driving aids	no / yes / with electricity

Environmental management	
* rest during hot hours of the day	yes / no
* milking hours aligned to the climate	yes / no

ANIMAL HEALTH	
* hair	yes / no shiny, smooth, continuous
	no / small / big lesions, haemorrhage
* % lameness / year	< 10% / 10-15% / 15-25% / 25-40%
	40-60% / 60-80% / >80%
* lameness during visit	< 10% / 10-15% / 15-25% / 25-40%
	40-60% / 60-80% / >80%
* locomotion score	1:.....2:.....
	3:.....4:.....
	5:.....
* hocks	bone formation / soft tissue / entire leg
	< 5% / 5-10% / 10-15% / 15-25% / 25-40%
	40-60% / 60-80% / >80%
* carpus	< 5% / 5-10% / 10-15% / 15-25% / 25-40%
	40-60% / 60-80% / >80%
* claws	form good / bad
	angle good / bad
	stand good / bad
* clinical mastitis / year	< 5 % / 5-10% / 10-15% / 15-25%
	25-40% / 40-60% / 60-80% / >80%
* clinical mastitis during visit	< 5 % / 5-10% / 10-15% / 15-25%
	25-40% / 40-60% / 60-80% / >80%
* abomasal dislocation	0% / 0-5 % / 5-10% / 10-15% / >15%
* filling of the rumen (3 cows of each lactation stadium)	1:.....2:.....
	3:.....4:.....
	5:.....
* % milk fever / year	0% / 0-5 % / 5-10% / 10-15% / >15%
* acetonaemia	0% / 0-5 % / 5-10% / 10-15% / >15%
* body condition score	1:.....2:.....
	3:.....4:.....
	5:.....
* % rumen acidosis / year	0-5 % / 5-10% / 10-15% / >15%
* fertility	good / sufficient / moderate / bad
* calving	0-5% / 5-10% / 10-15% / >15%
* cow mortality	… %

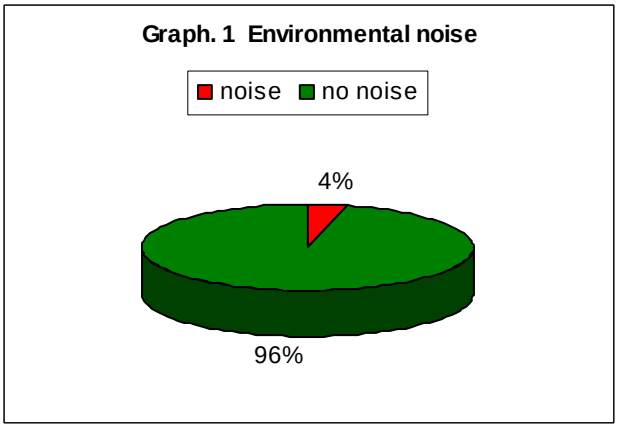
Appendix 4: Results parameters

The results show the parameters with the different options. Behind the options are the results found at a number of farms. For example, the parameter ‘environmental noise’ is scored at 26 farms. At 1 farm there was a lot noise and at 25 farms there was not much noise.
The graphics show these results in percentages.

General

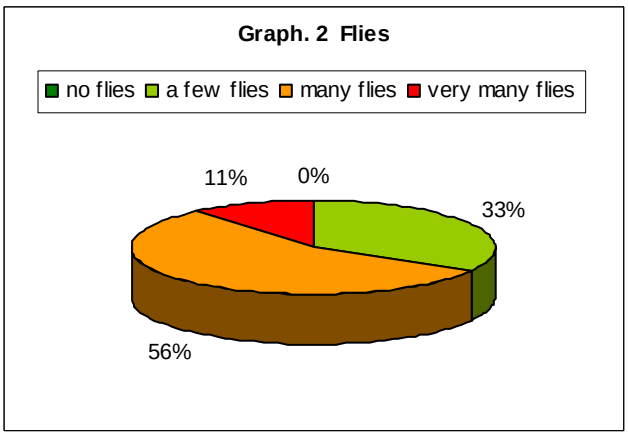
Environmental noise

If there is a lot of noise	1 / 26
If there is not much noise	25 / 26



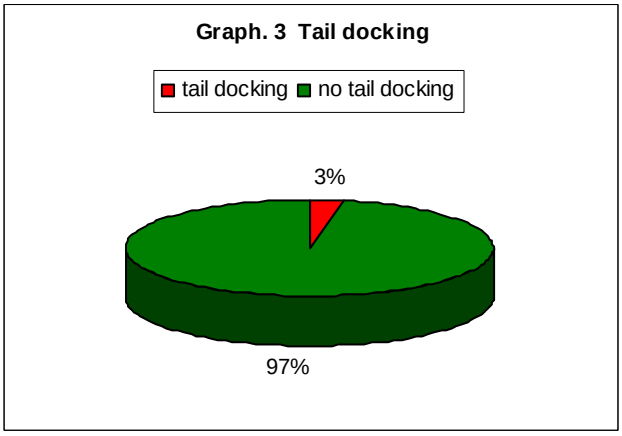
Flies

No flies	0 / 9
A few	3 / 9
Many flies	5 / 9
Very many flies	1 / 9



Tail docking

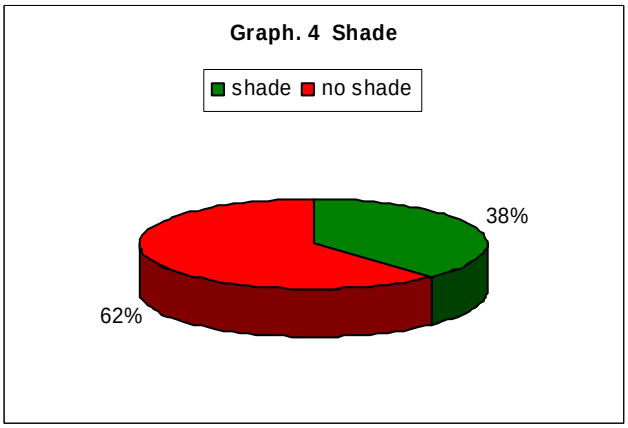
Tails docked	1 / 34
Tails not docked	33 / 34



Waiting room

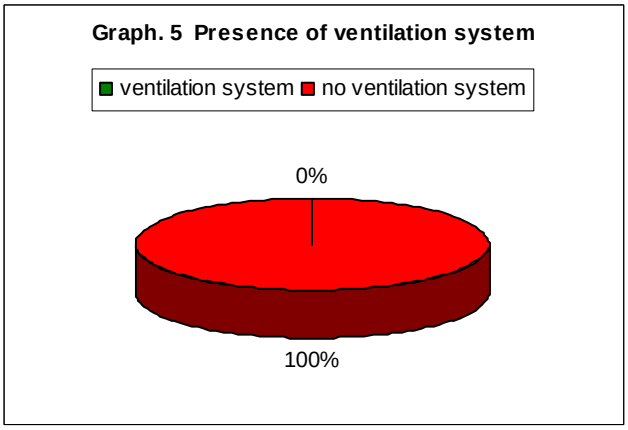
Shade

If there is shade in the waiting area	11 / 29
If there is no shade in the waiting area	18 / 29



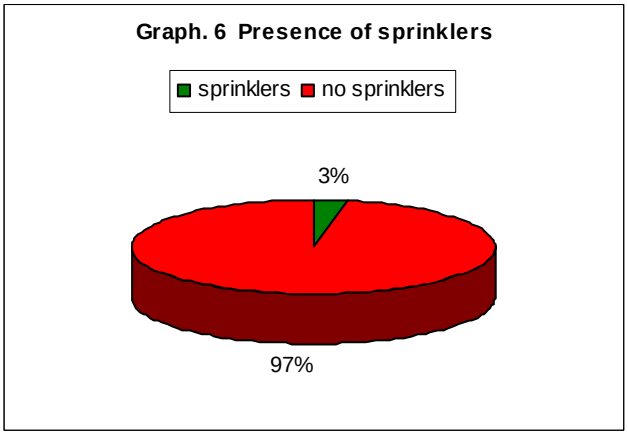
Presence of a ventilation system

If there is a ventilation system present	0 / 29
If there is no ventilation system present	29 / 29



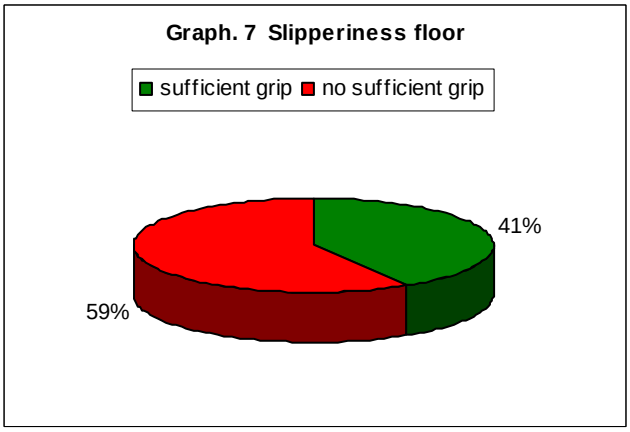
Presence of sprinklers

If there are sprinklers	1 / 34
If there are no sprinklers	33 / 34



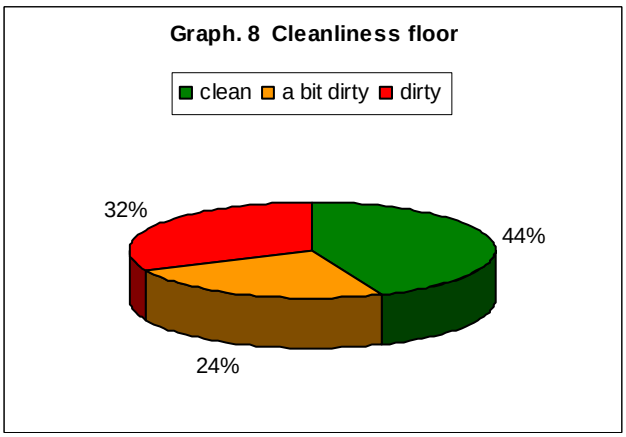
Slipperiness floor

Sufficient grip present	12 / 29
No sufficient grip present	17 / 29



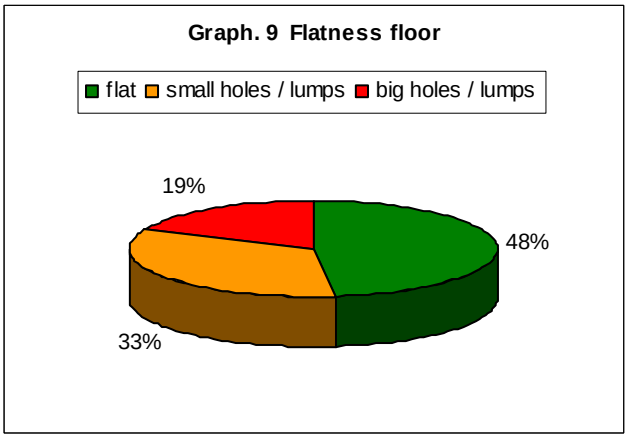
Cleanliness floor

A clean floor	11 / 25
A bit dirty floor	6 / 25
A dirty floor	8 / 25



Flatness floor

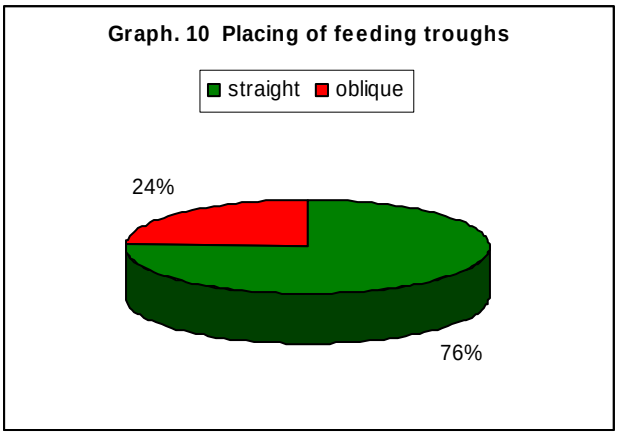
Flat floor	13 / 27
Small holes / lumps	9 / 27
Big holes / lumps	5 / 27



Milking parlour

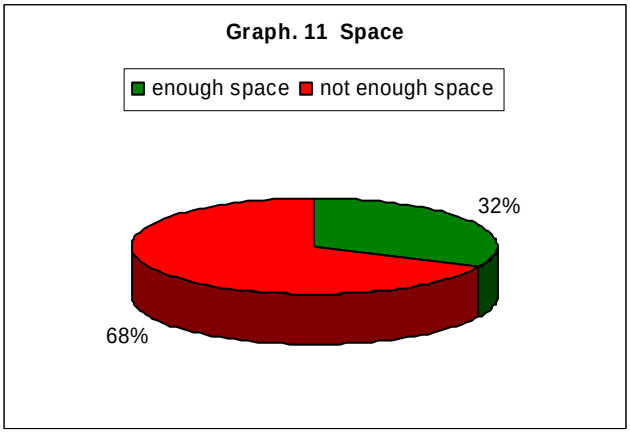
Placing of feeding troughs

Straight in front of the head	19 / 25
Oblique in front of the head	6 / 25



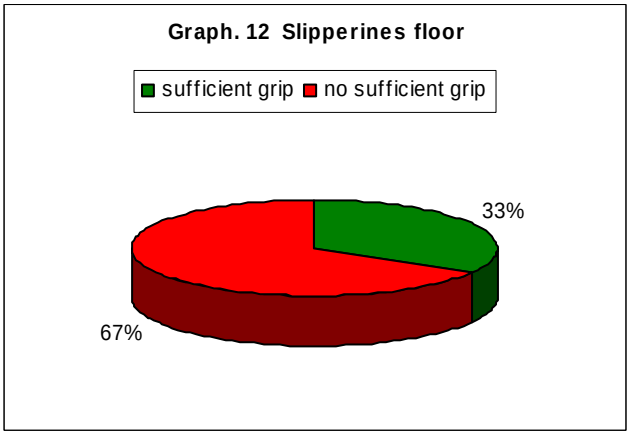
Space

If the cow has enough space	9 / 28
If the cow doesn't have enough space	19 / 28



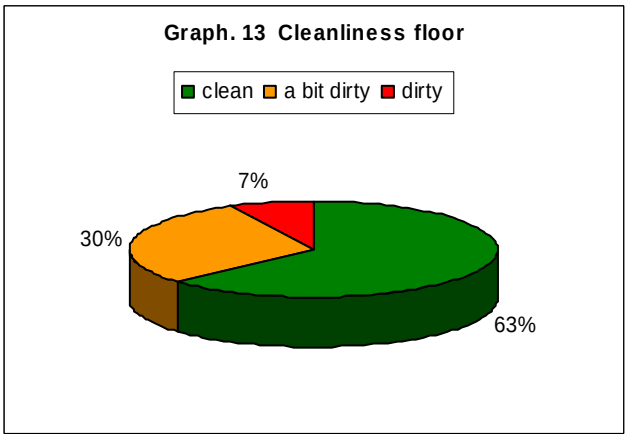
Slipperiness floor

Sufficient grip present	10 / 30
No sufficient grip present	20 / 30



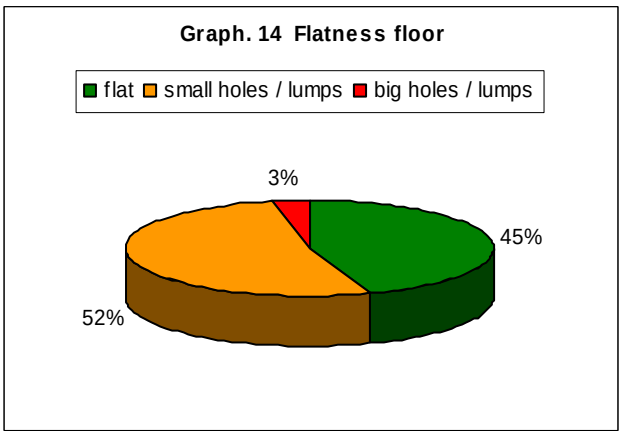
Cleanliness floor

A clean floor	16 / 26
A bit dirty floor	8 / 26
A dirty floor	2 / 26



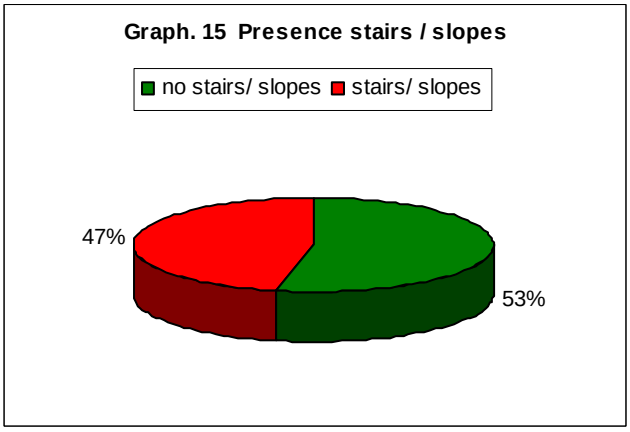
Flatness floor

Flat floor	13 / 29
Small holes / lumps	15 / 29
Big holes / lumps	1 / 29



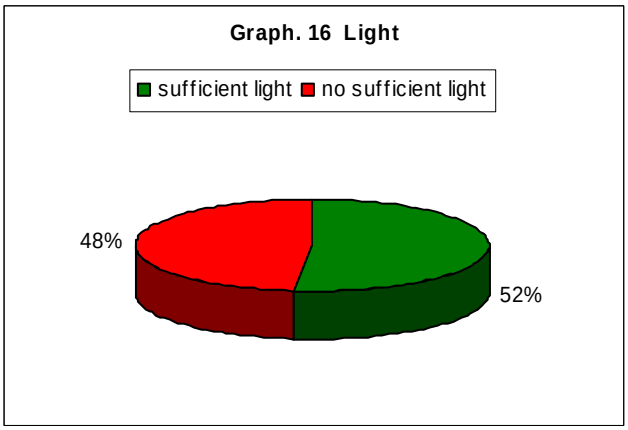
Stairs and slopes

Stairs or slopes present		14 / 30
No stairs or slopes present		16 / 30



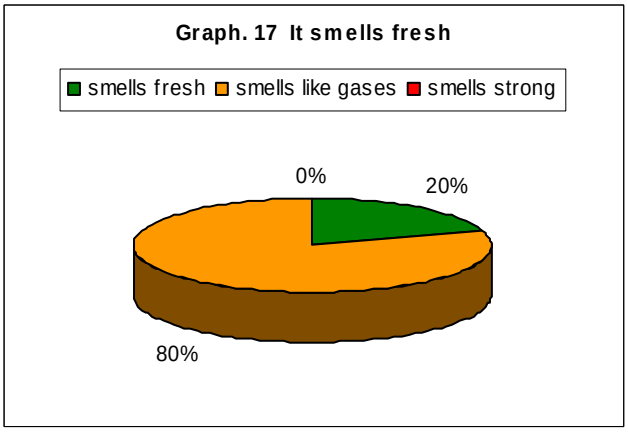
Light

If there is sufficient light in the barn	→ 3	15 / 29
If there is not enough light in the barn	→ 0	14 / 29



It smells fresh

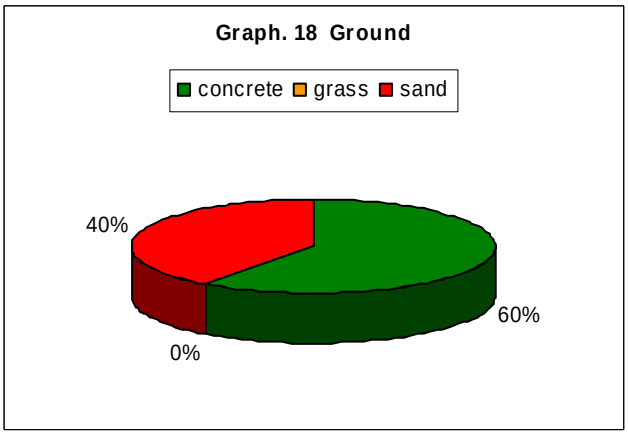
If it smells fresh	2 / 10
If it smells like gases	8 / 10
If it smells very strong	0 / 10



Exit milking parlour

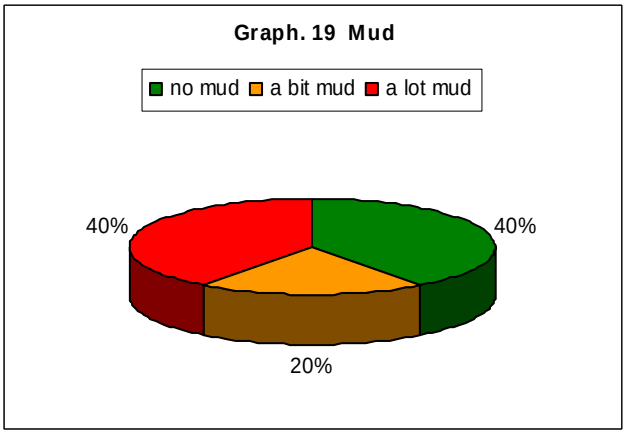
Ground

Concrete	6 / 10
Grass	0 / 10
Sand	4 / 10



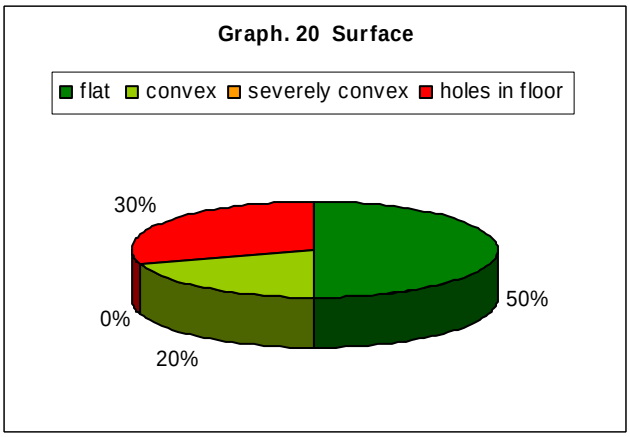
Mud

No mud	4 / 10
A little bit mud	2 / 10
A lot mud	4 / 10



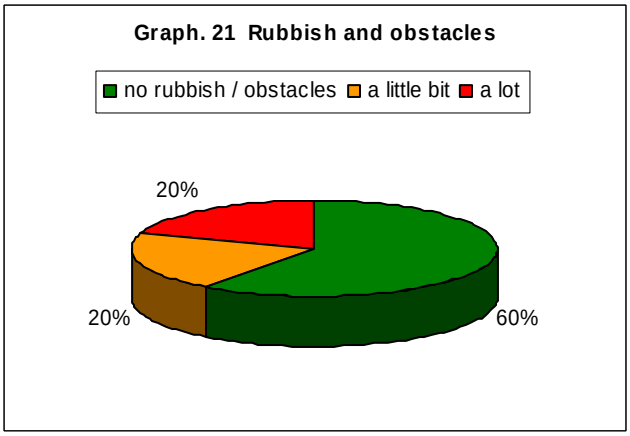
Surface

A flat surface	5 / 10
A convex surface	2 / 10
Severely convex surface	0 / 10
Holes in the floor	3 / 10



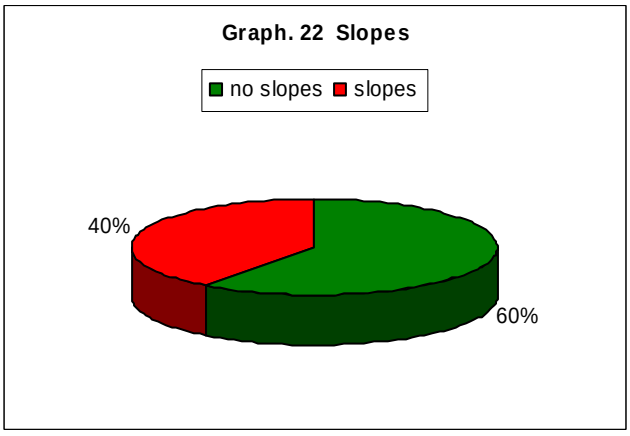
Rubbish and obstacles

No rubbish or obstacles	6 / 10
A little bit rubbish or obstacles	2 / 10
Lots of rubbish or obstacles	2 / 10



Slopes

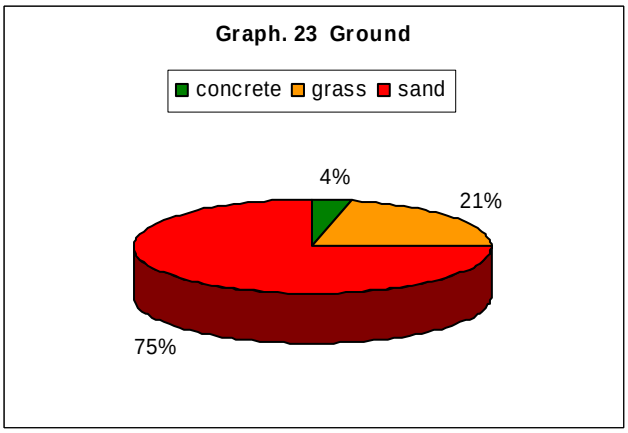
No slopes present	6 / 10
Slopes present	4 / 10



Walkways

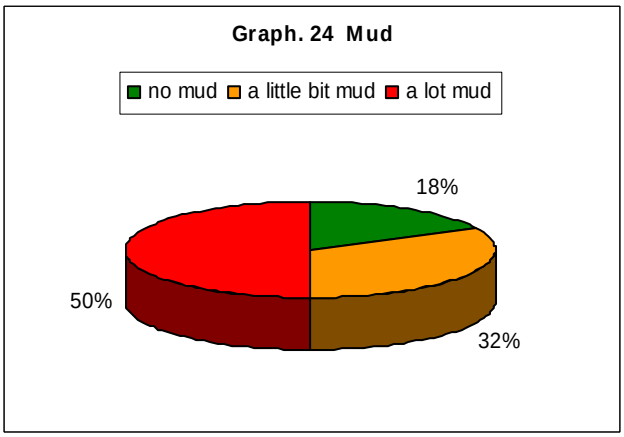
Ground

Concrete	1 / 28
Grass	6 / 28
Sand	21 / 28



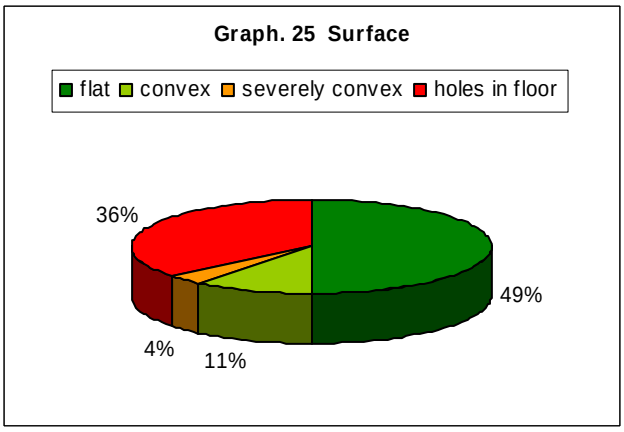
Mud

No mud	5 / 28
A little bit mud	9 / 28
A lot mud	14 / 28



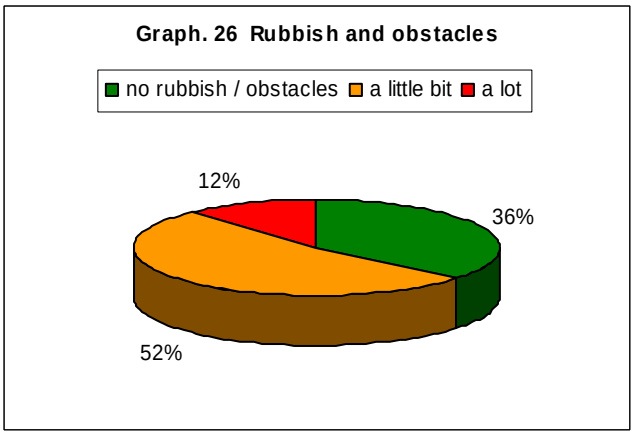
Surface

A flat surface	14 / 28
A convex surface	3 / 28
Severely convex surface	1 / 28
Holes in the floor	10 / 28



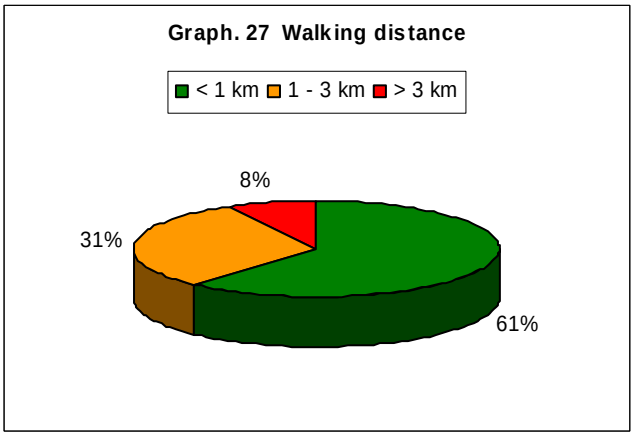
Rubbish and obstacles

No rubbish or obstacles	9 / 25
A little bit rubbish or obstacles	13 / 25
Lots of rubbish or obstacles	3 / 25



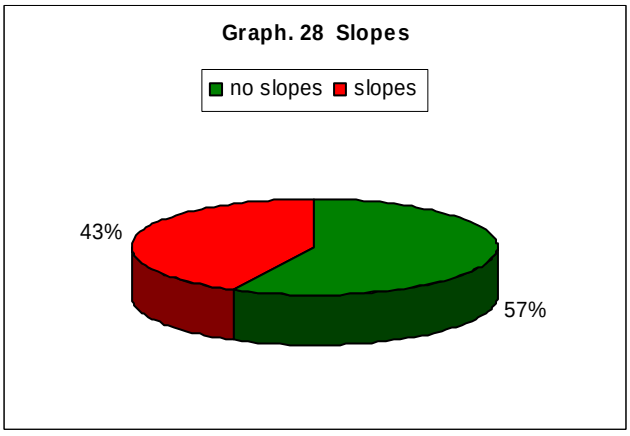
Distance to walk

< 1 km.	8 / 13
1 – 3 km.	4 / 13
> 3 km.	1 / 13



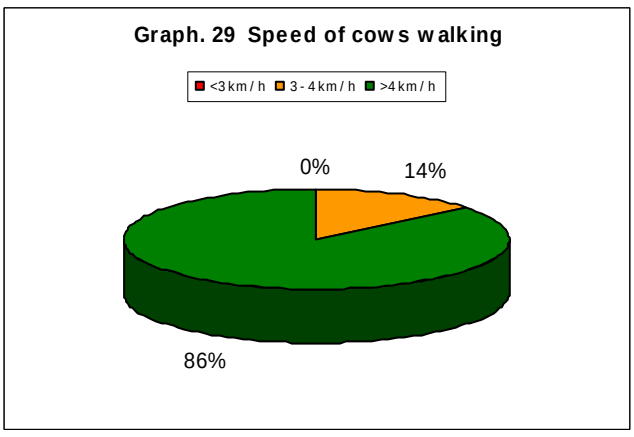
Slopes

No slopes present	16 / 28
Slopes present	12 / 28



Speed of cows walking

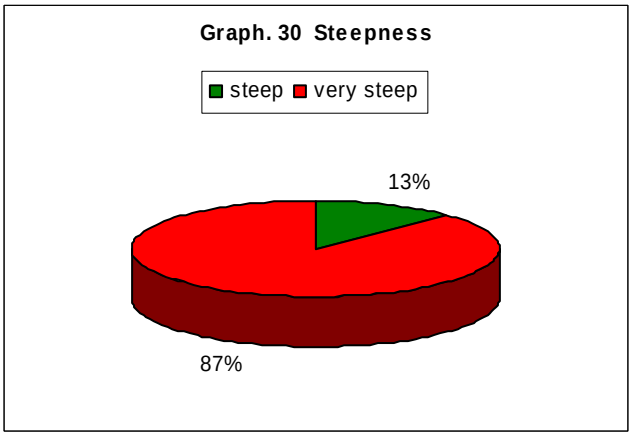
< 3 km. p/h	0 / 7
3 – 4 km. p/h	1 / 7
> 4 km. p/h	6 / 7



Loading site

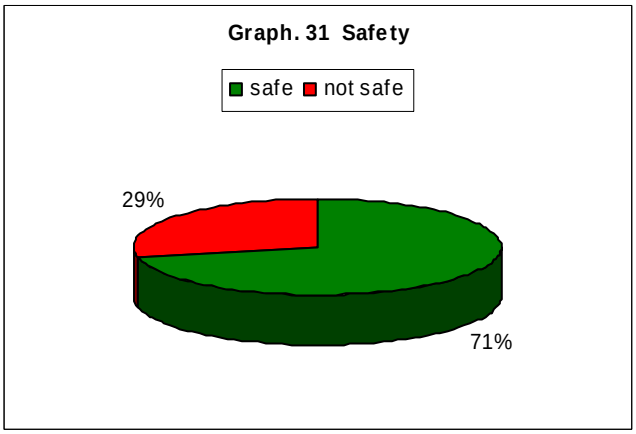
Steepness

steep	1 / 8
Very steep	7 / 8



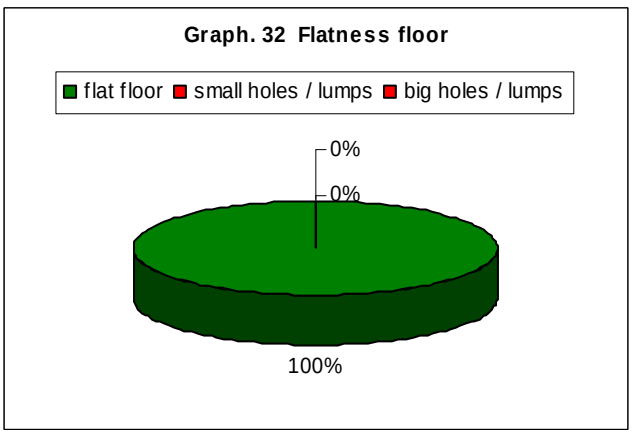
Safety

Loading site is safe	10 / 14
Loading site is not safe	4 / 14



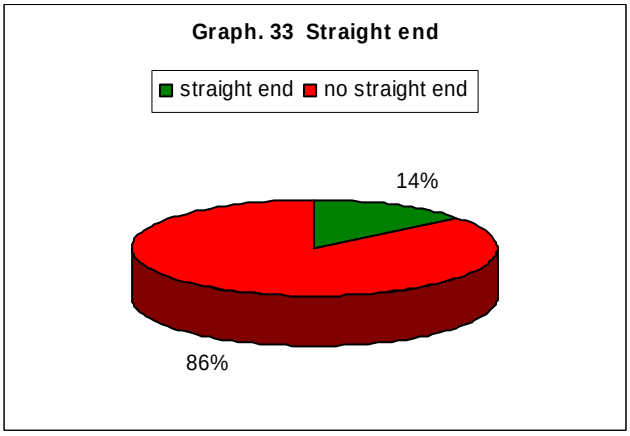
Flatness floor

Flat floor	6 / 6
Small holes / lumps	0 / 6
Big holes / lumps	0 / 6



Straight end

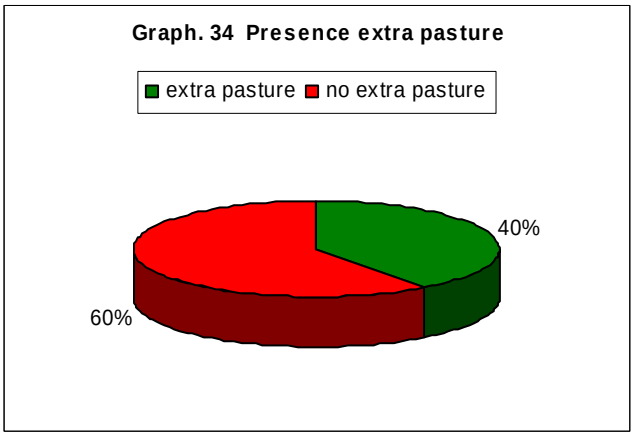
If the loading site ends straight	2 / 14
If the loading site doesn't end straight	12 / 14



Pastures

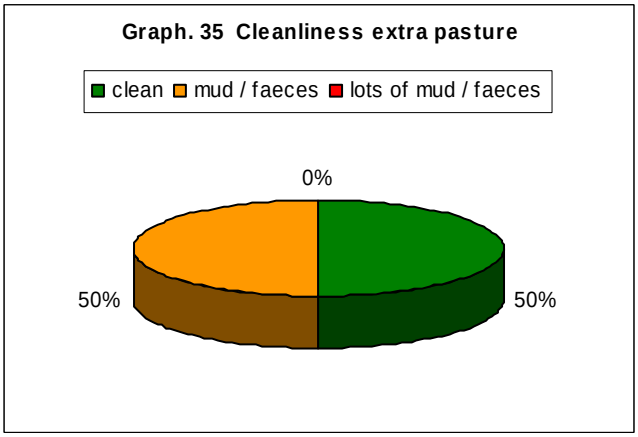
Presence extra pasture

Extra pasture present	2 / 5
No extra pasture present	3 / 5



Cleanliness extra pasture

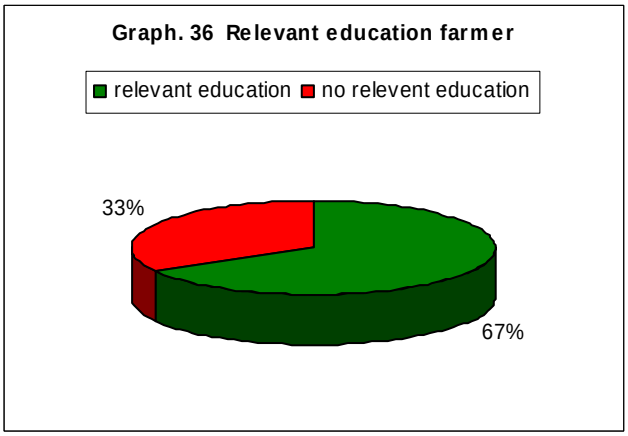
Clean	1 / 2
Mud / faeces	1 / 2
Lots of mud / faeces	0 / 2



Farmer and staff

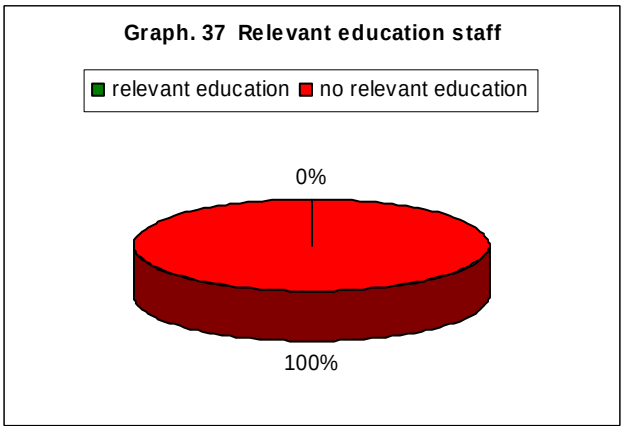
Relevant education farmer

He has a relevant education	2 / 3
He doesn't have a relevant education	1 / 3



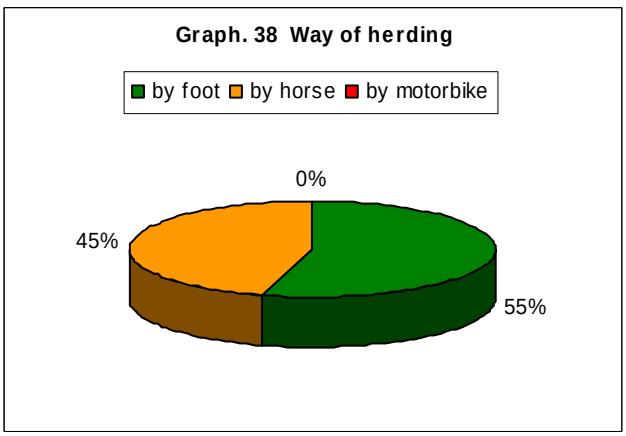
Relevant education staff

The staff has a relevant education	0 / 3
The staff doesn't have a relevant education	3 / 3



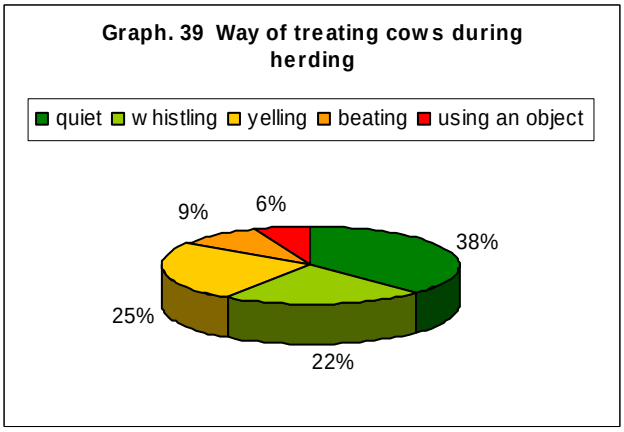
Way of herding

By foot	12 / 22
By horse	10 / 22
By motorbike	0 / 22



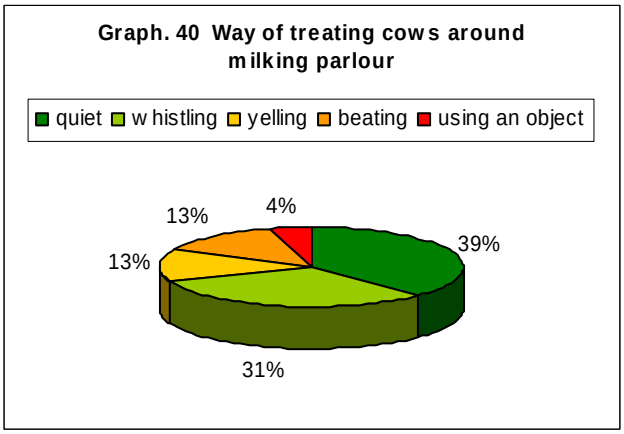
Way of treating the cows during herding

Quiet	12 / 32
Whistling	7 / 32
Yelling	8 / 32
Beating (hitting / kicking)	3 / 32
Using an object	2 / 32



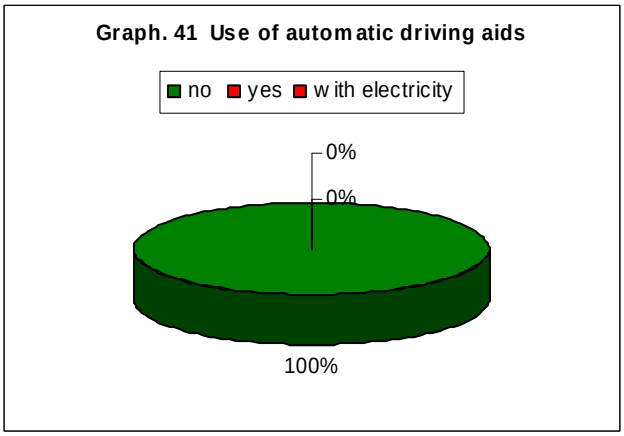
Way of treating the cows around the milking parlour

Quiet	17 / 35
Whistling	4 / 35
Yelling	6 / 35
Beating (hitting / kicking)	6 / 35
Using an object	2 / 35



Use of automatic driving aids

No	7 /7
Yes	0 / 7
With electricity	0 / 7



Appendix 5: Validation of the scoring system

This table shows the scores achieved by the farms of the validation.
The red numbers in the minimum score are applied to the farms where some parameters could not be scored. A parameter that is not scored is marked as an 'x'.
The minimum amount of points is adapted when a parameter could not be scored.
A parameter with a maximum of 3 points has 1 point deduction in the minimum score.
A parameter with a maximum of 5 points has 2 points deduction in the minimum score.
A parameter with a maximum of 20 points has 7 points deduction in the minimum score.
At some farms there was no loading site. These farms get the average score of 3 points assigned.

Table 3 Validation of the pasture-based scoring system

	Min.	Max.	1	2	3	4	5	6	7	8	9
General	8 (7)	20	**1**	**-17**	**-9**	**1**	**8**	**-21**	**-11**	**3**	**-3**
Fear behaviour		**5**	3	0	3	5	3	0	3	0	3
Stretching when raising from the pasture		**3**	x	x	x	x	x	x	X	x	x
Tails are hanging straight and relaxed		**3**	2	0	0	0	0	0	0	3	0
Broken tails		**0 (-100)**	-3	0	-4	-3	0	-5	0	0	0
Bellowing		**4**	4	4	4	4	4	2	4	4	4
Environmental noise		**0 (-5)**	0	0	0	0	0	0	0	0	0
Flies		**0 (-5)**	-2	-4	-4	-2	-4	-4	-4	-2	-5
Tail docking		**0 (-5)**	0	-5	0	0	0	0	0	0	0
Cleanliness score		**5 (-5)**	0	0	0	0	5	0	-5	0	0
Milking parlour and waiting area	2	5	**4**	**-2**	**4**	**4**	**5**	**0**	**4**	**0**	**3**
Behaviour		**3 (-3)**	3	0	3	3	3	0	3	0	3
Max. time waiting before entering the milking parlour		**2**	1	0	1	1	2	1	1	1	0
Waiting area	9	18	**7**	**-15**	**-11**	**-9**	**7**	**-17**	**9**	**-19**	**7**
Shade		**6 (-6)**	6	-6	-6	-6	6	-6	6	-6	6
Presence of a ventilation system		**1**	0	0	0	0	0	0	0	0	0
Presence of sprinklers		**5**	0	0	0	0	0	0	0	0	0
Slipperiness floor		**2**	0	0	2	2	0	0	0	0	0
Cleanliness floor		**2**	0	1	1	2	2	1	2	1	1
Flatness floor		**2**	2	2	2	2	0	1	1	0	1

Milking parlour	**9 (8)**	**19**	**14**	**9**	**10**	**16**	**4**	**2**	**4**	**8**	**9**
Placing of feeding troughs		**3**	3	3	3	3	0	3	0	3	3
Space		**3**	3	3	0	3	0	0	0	0	3
Slipperiness floor		**1**	0	0	1	1	0	0	0	0	0
Cleanliness floor		**1 (-1)**	0	0	1	1	1	0	1	1	1
Flatness floor		**1 (-1)**	1	1	1	1	-1	0	1	0	0
Stairs and slopes		**2**	2	0	2	2	2	0	0	2	0
Walking related to the placement of the shafts		**2**	2	2	2	2	2	2	2	2	0
Light		**2**	2	0	0	2	2	0	2	0	2
It smells nice		**1 (-2)**	1	0	0	1	0	0	0	0	0
% kicking cows		**3 (-3)**	x	x	x	x	x	x	x	x	x
Exit milking parlour	**3**	**6**	**6**	**3**	**-1**	**6**	**-7**	**-5**	**6**	**-9**	**-3**
Floor		**1 (-1)**	1	1	1	1	1	1	1	-1	-1
Mud		**2 (–2)**	2	0	0	2	-2	-2	2	-2	-2
Surface		**2**	2	2	0	2	0	0	2	1	2
Rubbish and obstacles		**0 (–2)**	0	0	0	0	-2	-1	0	-1	0
Slopes		**1**	1	0	0	1	1	1	1	0	1
Water	**16 (14)**	**33**	**20**	**12**	**15**	**20**	**15**	**15**	**6**	**14**	**14**
Ad libitum water available		**10**	5	0	0	5	0	0	0	0	0
Type of place to drink		**3**	3	3	3	3	3	3	3	3	3
Cleanliness		**5**	5	3	5	5	5	5	0	3	3
Temperature		**5**	2	2	2	2	2	2	2	5	5
Distance from the pasture with cows to the place to drink		**3**	3	3	3	3	3	3	3	1	1
Sufficient amount and size of drinking troughs		**5**	x	x	x	x	x	x	x	x	x
Safety of the drinking trough		**2**	2	2	2	2	2	2	2	2	2
Feeding sites	**13**	**27**	**11**	**11**	**11**	**15**	**11**	**11**	**7**	**11**	**7**
Additional feeding sites in the pasture		**10**	0	0	0	0	0	0	0	0	0
Surface		**3**	3	3	3	3	3	3	3	3	3
Cleanliness of the surface		**3**	3	3	3	3	3	3	3	3	3

Feeding place per cow		**3**	3	3	3	3	3	3	3	3	3
Contamination of the feeding site		**0 (-3)**	0	0	0	0	0	0	0	0	0
Distance from the pasture to the feeding site		**3**	3	3	3	1	3	3	1	3	1
Quality		**5**	0	0	0	5	0	0	0	0	0
Walkways	**9 (8)**	**18**	**14**	**8**	**-4**	**-8**	**-12**	**-6**	**-18**	**-18**	**4**
Floor		**3**	1	0	0	0	1	1	0	0	0
Mud		**5 (–5)**	5	5	0	0	-5	-5	-5	-5	0
Surface		**3**	3	0	0	0	0	3	0	0	3
Rubbish and obstacles		**0 (–5)**	0	0	-3	-3	-3	-3	-3	-3	0
Walking distance		**3**	3	1	3	1	3	3	1	3	1
Slopes		**2**	2	2	2	2	2	2	2	0	2
Speed of cows walking		**2**	x	x	x	x	x	x	x	x	x
Loading site	**0**	**2**	**1**	**1**	**0**	**0**	**1**	**0**	**1**	**1**	**0**
Steepness		**0 (-1)**	x	x	-1	-1	x	-1	-1	x	-1
Safety		**1**	x	x	1	1	x	1	1	x	1
Flatness floor		**1**	x	x	1	1	x	1	1	x	1
Straight end		**0 (-1)**	x	x	-1	-1	x	-1	0	x	-1
Pastures	**35**	**70**	**60**	**40**	**60**	**60**	**5**	**25**	**60**	**5**	**40**
Shade during hot hours of the day		**20 (-20)**	20	0	20	20	-20	20	20	-20	0
Food availability		**20 (-20)**	20	20	20	20	20	10	20	20	20
Mud		**10 (-10)**	10	10	10	10	10	0	10	10	10
Rubbish and obstacles		**10 (-10)**	10	10	10	10	10	0	10	10	10
Presence extra pasture		**5**	0	0	0	0	0	0	0	0	0
Mud extra pasture		**5**	0	0	0	0	0	0	0	0	0
Farmer and staff	**35 (28)**	**70**	**40**	**22**	**35**	**45**	**40**	**40**	**-48**	**-28**	**30**
Relevant education farmer		**5**	0	0	0	5	0	0	0	0	0
Relevant education staff		**5**	0	0	0	0	0	0	0	0	0
Way of herding		**10 (-10)**	10	10	10	10	10	10	0	10	0
Way of treating the cows during herding		**20 (-15)**	x	x	x	x	x	x	x	x	x
Way of treating the cows around		**20 (-15)**	20	5	15	20	20	20	-20	-20	20

the milking parlour											
Use of automatic driving aids		**10 (-10)**	10	10	10	10	10	10	10	10	10
Environmental management	**5**	**10**	**10**	**10**	**-5**	**10**	**10**	**10**	**-5**	**10**	**-5**
Rest during hot hours of the day		**5**	5	5	0	5	5	5	0	5	0
Milking hours aligned to the climate		**5**	5	5	0	5	5	5	0	5	0
Animal health	**100**	**202**	**152**	**117**	**165**	**187**	**142**	**137**	**157**	**142**	**132**
Hair		**5 (-10)**	5	5	3	5	5	5	5	5	5
% lameness / year and locomotion		**25 (-25)**	25	-10	25	25	25	25	15	25	5
Hocks		**20 (-60)**	20	20	20	20	20	20	20	20	20
Carpus		**20 (-60)**	20	20	20	20	20	20	20	20	20
Claws		**20**	20	20	20	20	10	10	20	20	10
% mastitis /year		**15 (-15)**	-5	0	-5	15	5	5	10	-3	0
Abomasal dislocation		**10 (-15)**	10	10	10	10	10	10	10	10	10
Filling of the rumen		**5 (-10)**	0	5	5	0	0	0	5	5	5
% milk fever /year		**5(-10)**	0	0	5	0	0	-5	5	-2	-5
Acetonaemia		**5 (-15)**	5	5	5	5	5	5	5	5	5
Body condition score		**17**	12	12	17	12	12	12	12	12	17
% Rumen acidosis / year		**15**	15	15	15	15	15	15	15	15	15
Fertility		**25 (-10)**	10	0	10	25	0	0	0	0	10
Calving		**15**	15	15	15	15	15	15	15	10	15
Cow mortality		**0 (-500)**	x	x	x	x	x	x	x	x	x
Total		**500**	**340**	**199**	**270**	**347**	**229**	**191**	**172**	**120**	**235**