**Cow Compass: a Dutch monitoring system of risk factors for the production process of milk.**

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**Abstract**
Cow Compass (CC) is an instrument for the farmer and his veterinary advisor to determine risk factors for the whole milk production process on dairy farms after a thorough inspection of data, herd and farm. Primarily, CC has been developed from a management tool for farmers to a system for monitoring farm management issues such as milking, feeding and water, housing and husbandry, animal welfare, work routines, animal health and young stock. CC has been implemented on voluntary basis in the terms of the delivery of most of the Dutch dairy companies. The CC has to be carried out twice a year on participating farms.
In this paper, all relevant issues of the CC are described including the role of the local veterinarian, who has to be certified to carry out the CC on dairy farms after a six-day training. The prospective value of CC will be discussed.

**Key words**
Hazard, prospective, dairy, quality, veterinarian

## Introduction

Food quality, animal welfare and sustainability have been the main management issues on dairy farms. They can be combined to the term milk quality that has been a major issue in countries all over the world. A clear example is the fact that, to this day, the milk market experiences the consequences of the Chinese melamine scandal in 2008. Especially for countries that are exporting most of the produced milk products, an unlimited trust in the quality of products by their clients is essential. Besides that, the role and influence of stakeholders such as retail companies, animal protection organizations, consumers and the government on aspects of environment, animal welfare and animal health is still increasing.
A main issue is the goal, set by the Dutch dairy industry, with regard to a higher longevity of dairy cows in 2020. Animal health and welfare are key factors to pick up this target. Related to this, many studies have been carried out on survival rates including in the United Kingdom, United States and Sweden (1, 3, 7), on risk factors of survival (6, 13), on welfare (5), on the relation between reproduction and longevity (14), and on the relation between production and welfare (4). Also for the dairy farmers, these aspects are of major importance in terms of economic profitability. So, a common interest exists to optimize the various aspects of the production process of milk in dairy farms.
A dairy farm is very complicated in its structure, because it consists actually of four major activities such as soil management, crop production, milk production and young stock. They can be evaluated as separate activities; however the results of the evaluations should be approached integrally, because of their close relationship. Over the years, more and more data became available by the storage in management systems on dairy farms or in central databases. However, the availability of data will not ensure a correct interpretation of these data. Data are only valuable if integrated with data of the clinical inspection of cows and calves and of the farm as a whole (e.g. housing, feeding, and water). That is par excellence the competence of the veterinary practitioner, who has been trained to connect clinical findings with pathophysiological disturbances. However, all collected data are a reflection of farmers' management in the past. It is impossible to change the past, so, advisors have to focus on a more preventive way of working on animal health and welfare, including crop production, feeding management, housing, husbandry, milking technique and young stock.
On herd level, it is of major importance to have insight in the risk factors, that could hinder the objectives set (10,11). In the past, housing systems were developed on which cows had to adapt to, but, nowadays, the demands of cows has to be the starting point involving comfortable beddings, laying time, eating time, and room for expressing of natural behavior. External management is only a steering wheel for internal physiology of the cow. If external management activities do not line up with management activities inside the cow such as intermediary metabolism and immunological processes, the measures taken will most often not result in the desired improvements in herd performance. This is called the "inside-outside approach (2).
To analyse all welfare aspects on dairy farms, the Welfare Quality System© (WQS)(8) has been developed. This EU-project started in 2004 and took over five years to complete. WQS has been used for several years, but is considered to be very time consuming. Consequently, for a regular monitoring system on dairy farms, WQS has not been revealed as a practical system.
Cow Compass (CC) is a system that involves evaluation of risk factors for the production of milk, such as milking process, feeding and water, housing and husbandry, animal welfare, animal health, work routines and young stock. CC originates from projects on farm level into quality systems on dairy farms. The organization of farmers in the Northern part of the

Netherlands[2] started with study groups of farmers in good cooperation with a relatively small number of veterinarians. These farmers were motivated to improve herd management in a broad sense. Many aspects described above were subject of a study with 140 farmers. The farmers were divided into 14 study groups. Within the groups, data, management, results, and economic outcomes of each farmer were analyzed during the years. There was much room for discussion, exchanging experiences, but also much time was spent on teaching by experts on the different fields of interest. A small-scale dairy company[3] turned out to be very interested in implementing the results of this project in the terms of delivery of the farmers being member-suppliers. Especially the focus on the influence of a big diversity of hazards in farmer's management on the milk producing process on dairy farms was the most important trigger. Eventually, the system called Cow Compass was introduced. Twice a year, the CC has to be carried out on the participating farms and though within a few hours, including time needed for the (online) report. Nowadays, farmers of nearly all dairy companies have the possibility to enter the CC system. Participation is still voluntary, but is boosted by financial incentives. The system covers even some regulations from the Dutch Government, being periodic farm visits. The aim of this paper is to clearly describe the different issues in the CC and to discuss the practical value on dairy farms.

## Materials and Methods

The basic principles of CC, described in this paper, are based on the "Handbook Cow Compass 2014[4]". After that, the different parts of CC (milking, feeding and water, housing and husbandry, animal welfare, work routines, animal health and young stock) are explained together with the criteria of scoring. At the end, the discussion will especially emphasize the value CC might have in the contribution to an optimal milk quality, and a production process with special attention for animal welfare and sustainability.

## Basic principles

Basically, the CC is a system that shows how milk has been produced at a dairy farm. It is an assessment of the risk factors for the production of milk and has been carried out by the local veterinarian. The outcomes are advice for the farmer and a septagram, built according to the method of the Institute of Dutch Quality (INK)[5]. This septagram is a very informative way of showing the results.

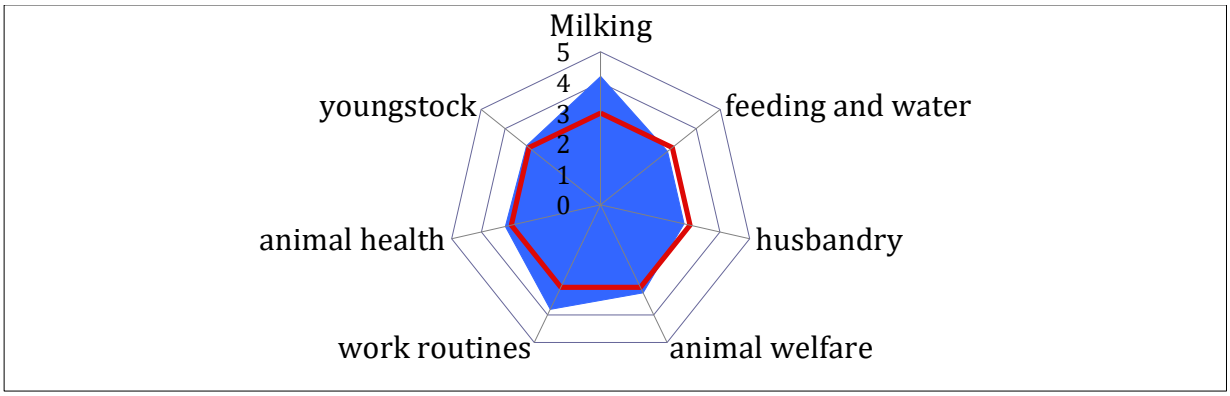


Figure 1. Example of a septagram generated from the Cow Compass system. The red line represents a medium risk level. The more a blue surface, the less risks were determined in the milk production proces.

[2] LTO Noord
[3] Cono cheesemakers
[4] The Handbook Cow Compass 2014 is at this moment only available in the Dutch language.
[5] The INK has been funded in 1991 on behalf of the Dutch Ministry of Economic Affairs (http://www.ink.nl/)

The seven parts are the Critical Success Factors (CSF). Each CSF consists of Performance Indicators (PI), that are built up from Management Control Points (MCP). There are around 40 PI's with in total more than 100 MCP's. The PI's are scored between 1 (high risk) and 5 (no risk). They do not have an identical impact on a specific CSF. For example, locomotion score and body condition score have a higher impact on animal welfare and thus a higher weighing factor than hygiene or general impression of the herd. Therefore, each PI has been multiplied by a weighing factor (1-3). The sum of the PI's including the weighing factors, divided by the number of PI's, results in one decimal CSF score (1-5). For the farmer, especially the MCP's are important, because by taking them into account, the farmer will be able to minimize or prevent the noted risks. The veterinarian, in good cooperation with the farmer, can give an advice regarding changing some aspects of farmer's management.

**Critical Success Factors**

*Milking*

There are two different ways of milking; milking in a conventional milking parlor (CMP) and the use of an automatic milking system (AMS). The design of the CSF milking results in a specific set of check points for each milking system that a farmer has to score (possible scores: yes, no, unknown) and the outcomes are further processed as MCP's. The questions, which are different for CMP and AMS systems, are subdivided into five parts, related to tank room, milking method, cleaning, system maintenance, and preventive measures. Each question represents an aspect related to milk quality. It is up to the veterinarian to control whether the farmer filled in the form correctly.

*Feeding and water*

Feeding and water in CC consists of seven PI's; conservation and hygiene of the silage storage, feeding management, feeding lactating and dry cows, and water quality of lactating and dry cows. For example, quality and quantity of feeding, frequency of feeding, and possibility for selection at the feeding fence are MSF's. Presence of secondary fermentation or mold on the silage is another one.

Water quality and quantity has been considered as an essential part of the CC, because milk consists for 87% of water. So, infectious diseases such as Salmonella might be a risk factor for milk production in farms with insufficient water quality.

*Housing and husbandry*

Housing and husbandry is an important CSF because of the implications of suboptimal housing on animal welfare, that can be strongly disturbed as result of locomotion problems. The four PI's of the CSF housing and husbandry are feeding fence (relation between number of cows, height and width), stall climate (light, ventilation and presence of a rotating brush), walking space (especially the surface), and lying comfort (number of boxes, hygiene, surface, and dimensions). The features and dimensions of the cubicles are based on the Holstein-Friesian cow. For other breeds different dimensions can be taken into account. The features and dimensions are guidelines that have to be interpreted by the veterinarian. The presence or absence of smooth surfaces on the tubes may be helpful in interpreting the findings done. Grazing is an important issue in relation to animal welfare and was also included in the CSF housing and husbandry; however, since the start of 2015, grazing has been placed in the CSF work routines.

*Animal welfare*

Animal welfare has become an important issue in the public debate in the Netherlands. Organisations of consumers, political parties, the Dutch government and retail companies are all driven to stimulate measurements to enhance animal welfare on farms. The dairy industry took the lead in implementing CC as a system to get insight in some aspects of animal welfare in dairy farms.

The CSF animal welfare comprises 9 PI's, to know cow activity, body condition score, locomotion score, hocks (injuries, loss of hair), hock swelling, hygiene score, abnormalities (rumen fill, manure), and general impression (hair, skin). For example, cow activity can be evaluated with the dodging test, that has to be carried out by a minimum of 20% of the herd. Cows can be judged as shy, restless, normal, quiet, and tame. The scores are given as shown in table 1.

| | **behaviour** | **% inactive cows** |
|---|---|---|
| score 1 | shy | > 30% not active |
| score 2 | restless | between 23% and 30% inactive |
| score 3 | normal | between 17% and 23% inactive |
| score 4 | quiet | between 10% and 17% inactive |
| score 5 | tame | < 10% inactive |

Table 1. Scoring of the dodging test as used in Cow Compass. Inactivity has been defined as cows that are not lying, eating or drinking, but are standing on the grids or half in the boxes.

*Work routines*

Amongst dairy farmers a large variation exists in work routines. In general, they include implementation of one or more preventive measures, nevertheless, risks in relation to animal health still exist on dairy farms. The five PI's are health status of infectious diseases, use of vaccinations, preventive measures (around calving, import, separated rearing until 6 months age), crossing lines of manure and feed and the use of a farm specific treatment plan.

In table 2 the weighing of some preventive measures around calving has been presented.

| | |
|---|---|
| Removing calf directly from the dam after calving | 3 |
| No mixed colostrum | 2 |
| Feeding milk replacer | 2 |
| No import of cows or calfs | 2 |
| Roughage for young stock without manure as fertilization | 1 |
| Calves < 6 months without contact with older calves or cows | 3 |

Table 2. The weighing of some preventive measures around calving in the Cow Compass.

*Disease incidence*

The disease incidence (mean per year) has been registered by the farmer in management systems, but validation of the data is needed because of the risk of differences between observed incidence (veterinarian) and recorded incidence (farmer). Besides data of antibiotic use, somatic cell count and a number of diseases (e.g. mastitis, lameness), the culling rate is an important point of attention. Table 3 presents the scores of the somatic cell count.

| | **BMSCC** | **% increased** |
|---|---|---|
| score 1 | > 300 | > 30% |
| score 2 | between 250 and 300 | between 25% and 30% |
| score 3 | between 200 and 250 | between 20% and 25% |
| score 4 | between 150 and 200 | between 15% and 20% |
| score 5 | < 150 | < 15% |

Table 3. The scoring of the bulk milk somatic cell count (BMSCC) in Cow Compass.

The recorded diseases include data of clinical mastitis, claw problems, retention of the fetal membranes, metabolic diseases, vaginal discharge, abortion, involuntary culling, and a category other diseases (e.g. liver fluke, infectious diseases).
Because of the mandatory periodic farm visits the current diseased cows have to be recorded as well, but this is beyond the scope of this paper.

*Young stock*
The CSF young stock consists of 4 PI's, namely feeding and water, housing, animal welfare and disease incidence. The supply of colostrum and the feeding and water before and after weaning are the main issues of this PI. In table 4 the rating of feeding and water for calves before weaning has been presented.

| | |
|---|---|
| No risk (score 5) | Colostrum ➔ milk replacer ➔ water, concentrate, hay ad lib |
| Moderate risk (score 3) |  |
| High risk (score 1) | Waste milk ➔ milk with high SCC ➔ only hay, no concentrate |

Table4: Rating of the risks for feeding and water for calves before weaning in Cow Compass.

Housing includes the period in which calves are housed in a straw bedding (5 months has been recommended), ventilation and hygiene. Other aspects are grazing and differences in age between individuals in one group.
Animal welfare includes body condition score in relation to age, growth, general impression, and dehorning regime. Important issues in animal welfare are the disease incidence in calves and the percentage of mortality within and after 24 hours after birth. The recorded diseases are diarrhea, respiratory problems, umbilical infections, parasitic diseases, and the occurrence of trichophyton spp.

**Discussion**
In the nineties of the 20$^{th}$ century studies were carried out into hazard management and quality assurance in dairy farms (10, 11). It was concluded that process control and product control according the Hazard Analysis Critical Control Point (HACCP) concept could provide opportunities for preventive health action and risk management. At the same time, projects were started up in the Northern Netherlands in order to develop practical tools that could support farmers and veterinarians to analyse risk factors for the milk production proces on dairy farms and, subsequently, to improve it by eliminating hazards. Besides that, data were

collected for detecting reference values for MSP's. Expert panels were invited to discuss these values and, at the end, to define the reference values in the CC definitely. This paper does not pretend to describe a scientific based study into the validity of CC, because the CC has not yet been validated in a scientific study. At the moment, a study has been started to examine the alleged prospective value of the different scorings in CC. If so, a valuable instrument will be available to enhance farmers' management by eliminating hazardous conditions. At this moment, the focus of the dairy industry in a country, in which 70% of the milk has been exported in and outside the European Union, has been mainly on improving animal welfare including animal health, in order to prevent risks in further processing milk. Besides that, there exists a focus on sustainability, not only economically driven, but also through political and public pressure. This means among others a higher longevity, that can only be achieved by optimal animal health. Dairy companies considered CC to be a practical instrument to achieve this goal. Therefore, the farmers were stimulated to participate in CC with the certified local veterinarian, who has to be trained in a six-day course, as the key-factor in the implementation on the farms. Hence, the certified veterinarians have been bi-annually evaluated by the trainers. Even though, the critical question might be asked if the scores do reflect the real situation regarding the different aspects of the milk production process in dairy farms. The scores and weighing factors are continuously under discussion based on experiences in the field. Thus, a non-scientific validated system (CC) has been implemented in the Dutch dairy industry, built up with data only tested under practical conditions supported by veterinary expertise.

The validity of data in quality systems and systems like CC, in which more or less farmer recorded data are used, has always to be taken into consideration. A distinction has to be made between farmer recorded data (e.g. health data) and data collected in central databases (e.g. milk production parameters, fertility parameters), that are normally more reliable. In a study of Parker Gaddis et al. (12), most health events reported on farms in the US had incidence rates lower than the average incidence rate found in the literature. In an Austrian study, Koeck et al. (9) concluded that farmer recorded health data could be used together with veterinarian diagnoses for genetic evaluations. Thus, the validity of data has been still under discussion with a possibly positive role of the veterinarian in enhancing the quality of data. The value in terms of farm management of retrospective data can be discussed. Normally, quality systems on dairy farms evaluate whether or not continuously realized data (e.g. SCC, culling rate, production parameters). Instead, the CC is a system, in which risk factors has been determined and analysed, that can be valuable for the (near) future. For example, a suboptimal feeding quality might be a problem at the moment of feeding, but the veterinary approach should be to analyze the current problem resulting in advice how to improve feed processing next year. Overcrowding is a strong risk factor that, in most cases, cannot be eliminated in the short term. The farmer has to get advice how to diminish the hazards as much as possible. In short, hazards have to be eliminated or, if impossible at short notice, the effects have to be minimised.

In conclusion, CC is a dynamic system for monitoring a number of farm management issues with a central role for the local veterinarian, who has to be certified to conduct the analysis and advices to the farmer properly. The Dutch dairy companies have implemented the system in their terms of delivery, but still voluntary at the moment. CC claims to be of more prospective value to the farmer. A current study might confirm that. The CC can be helpful for the farmer to eliminate risk factors resulting in improving farmer's management. For the dairy industry it provides a substantial advantage to ensure less hazardous milk processing, for the farmer economic profit because of better animal health and welfare, and for the veterinarian a higher quality of work.

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