Evaluation of management factors influencing the transition success in cattle on Dutch and Flemish dairy farms

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Abstract

This observational study provides information about management strategies on Dutch and Flemish dairy farms that possibly affect the transition period of the cow. A survey covering more than 90 questions, based on seven themes related to the management in the periparturient period was conducted on 36 farmers (17 from the Netherlands and 19 from Belgium). The results were visualized and linked to a new key performance indicator: the lactation onset value (LOV). This KPI is created to provide a method for benchmarking the success of transition on different farms throughout Europe. The participating farms were compared with each other for each question by their calculated LOV's. Factors which were associated with a better LOV were the occurrence of more than 100 calvings per year versus less than 100 and the introduction of the heifers into the lactating group versus the dry cow group. Other factors associated with a better LOV, but based on a small group of farmers, were feeding one ration during dry off versus two rations and taking milk reducing measures to all cows before drying off, instead of some cows. In conclusion, a large number of calvings per year, the introduction of heifers into the lactating herd, feeding a stable ration during the dry off period and taking measures to reduce the milk production before dry off for all cows might be success factors for the transition period. Now that a broad insight of the results and their influence on transition has been gained, more extensive statistical models should be set up and follow-up research should be carried out that zooms in on these aspects.

Key words

Transition period, dairy cows, cattle, management, risk/success factors, lactation onset value, LOV, Dutch, Flemish

Introduction

During the cycle of a cow, the transition period is a period of great importance (Zebeli et al., 2015; Roche et al., 2018; Pascottini et al., 2020). This period is defined as the period from a dry cow at three weeks pre partum to a high productive dairy cow three weeks after calving (Grummer, 1995). Most infectious or metabolic diseases occur during this period (Pascottini et al., 2020; Drackley, 1999). During transition, high-producing dairy cows – on which we have been selecting – are very susceptible for disease when aspects of management are not meeting the demands of the animal (Crowe et al. 2018). The combination of a decrease in dry matter intake (DMI), parturition stressors and metabolic adaptation (Mulligan & Doherty, 2008; Pascottini et al., 2020) can result in diseases like ketosis, milk fever, (endo)metritis (LeBlanc, 2010), retained membranes, mastitis and abomasal displacement (Drackley, 1999; Mulligan & Doherty, 2008). Cows with these diseases are not as profitable as could be, because of a lower milk production during disease (Drackley, 1999) and treatment costs.

The world population continues to grow, as the demand for milk. This need for milk will, from the looks of a few years ago, have doubled by 2050 (Rotz, 2017). In order to feed these mouths, an optimal production of milk is of great importance. Achieving an optimal production per cow is also one of the management strategies to reduce the green house gasses on a farm, as the emission of methane per kilogram reduces with a higher and more efficient production (Rotz, 2017).
Apart from the improvement of sustainability by the reduction of carbon footprint (Rotz, 2017) and the result of more milk available per cow, a successful transition on a farm level is also economically favorable. Last but definitely not least, a successful transition is beneficial for the cows' health and welfare, which is important for ethical reasons and the standards and values of our society.
Because of the effects from a successful transition on these levels, research into the biological events, nutritional and management strategies regarding this period are of great importance (Drackley, 1999). Over the past 30 years, numerous researches have been conducted to identify risk factors to the development of (subclinical) disease in dairy cattle during the transition period (Overton et al. 2017). This has resulted in the collection of data on dairy farms by means of collars, pedometers, milking robots, etc. (Overton et al. 2017) to analyse and monitor metabolic functions and herd health in dairy cows.

Management strategies change over time. For example: in the past, one group of dry cows with a dry period of 60 days was standard, but nowadays the use of two different groups and a shorter dry period is used on many farms (Cook & Nordlund, 2004). Approaches for an optimal transition management have been described elsewhere (Mulligan et al, 2006). Important factors in management are, for example, nutritional factors, the Body Condition Score at dry off and calving (Mulligan et al, 2006), the length of the dry period (Kok et al, 2019), housing, and claw- and udder management (Goossens, 2021).
It remains of great importance that there is not one strategy that works for all farms and even within a herd it is important to be able to adapt the transition management to the individual cow (Cook & Nordlund, 2004).

To evaluate transition management on a farm one needs to continuously monitor the success of transition. Ideally, it would be possible to determine metabolic parameters in the blood to monitor transition disease in cows, but unfortunately this is not the most practically and ethical favorable method for herd management as it would require blood collection of every cow. Biomarkers in milk and using the data from MPRs, which are performed on most farms in the Netherlands, could be good alternatives. Over the last two years, a new Key Performance Indicator (KPI) to evaluate the transition success in dairy cows using artificial intelligence called the Lactation Onset Value (LOV) has been developed and published in multiple studies (Liseune et al., 2020; 2021; Salamone et al., in review) in a large VLAIO study in Flanders (Overzicht gesteunde LA-trajecten | Agentschap Innoveren en Ondernemen, 2018). This new KPI can be easily calculated and applied on dairy farms throughout Europe.

This research studies the transition risk/success factors on Dutch and Flemish dairy farms. Management factors are analyzed in combination with the LOV for the Dutch farms and compared with the Flemish farms. This study provides practical information for further research to improve the efficiency of transition management and therefore improve sustainability on dairy farms.

Material and methods

This observational study includes a risk factor survey with closed questions for 17 Dutch dairy farms. The participating dairy farms are all clients from the Large Animal practice from Utrecht University and are all respondents of an invitation to the project. The work of Goossens (2021), a master student from Ghent University who conducted the same survey on 19 Flemish farms, was hereby continued with the Dutch farms. The data of the Flemish survey were shared and re-analysed with the Dutch responses, so that data of 36 farms were used. The questions comprised the themes 'claw health', 'management of the dry period', 'nutrition' 'housing', 'calving management' and 'follow-up fresh cows'.

The survey has been taken by one person, who filled in the answers in presence of the farmer. The questions were closed, so it could be used in a quantitative data analysis. The data were processed with the use of Tableau (descriptive analysis) and R (statistical analysis). The results of the survey were linked to the transition success of the farms by means of the LOV. T-tests were used to analyze the effect of risk/success factors on the LOV of the preceding year the survey was taken (January 2020 – March 2021).

Results

General

Of all 36 farms in this study, 17 were from the Netherlands and 19 were from Belgium. 41.7% of the farms had 50-100 dairy cows and 38.9% had a herd size between 100 and 200. The first group were mainly Flemish farmers and the latter mostly Dutch (Figure 1).

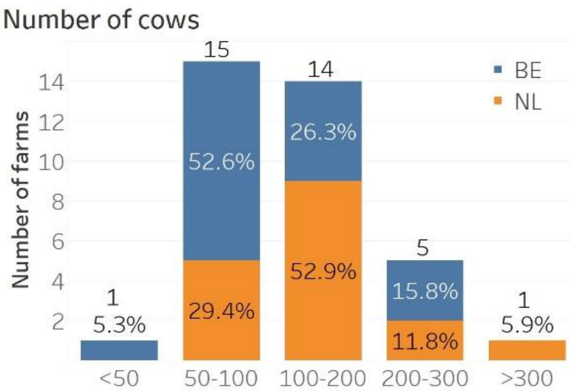

Figure 1: Number of cows of participating farms and distribution of the two countries.

Most farms (63.9%) had a conventional milking system, which was similar in both countries. All Dutch and 47.4% of the Flemish farmers were housing the dry cows in cubicles, 31.6% of the Flemish farmers in straw barns and 21% in both.

LOV – General

For each question in the survey, farmers who gave the same answers were grouped and compared with the other group(s) by colour patterns in the same figure (Figure 2). Each question that showed a possible association between the responses and the LOV of the

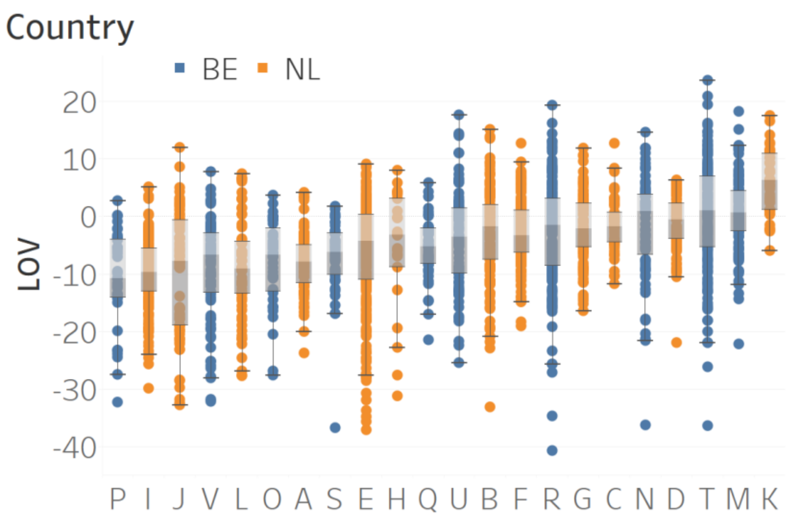

Figure 2: The 22 farms with the calculated LOV's of each cow, visualized as a box-and-whisker plot, arranged in ascending order. Each letter is a farm, each dot is a cow on that farm. The colour distribution shows the nationality of each farm.

farms was statistically analysed with a T-test on the average LOV's of last year (January 2020 - March 2021) of two different groups of responses.

Figure 2 shows that the distribution of the two countries was similar: the Dutch farms were evenly divided between the 50% lowest scoring farms and the 50% highest scoring farms, which was the same for the Flemish.
There seemed to be an association between herd size and the LOV (Figure 3), as 81.8% of the 11 highest scoring farms had herds larger than 100 cows (which was 69.2% of the farms in that group) and 63.6% of the 11 lowest scoring farms were farms with herds consisting of 1-100 cows (77.8%). This difference tended to be significant (P = 0.08).

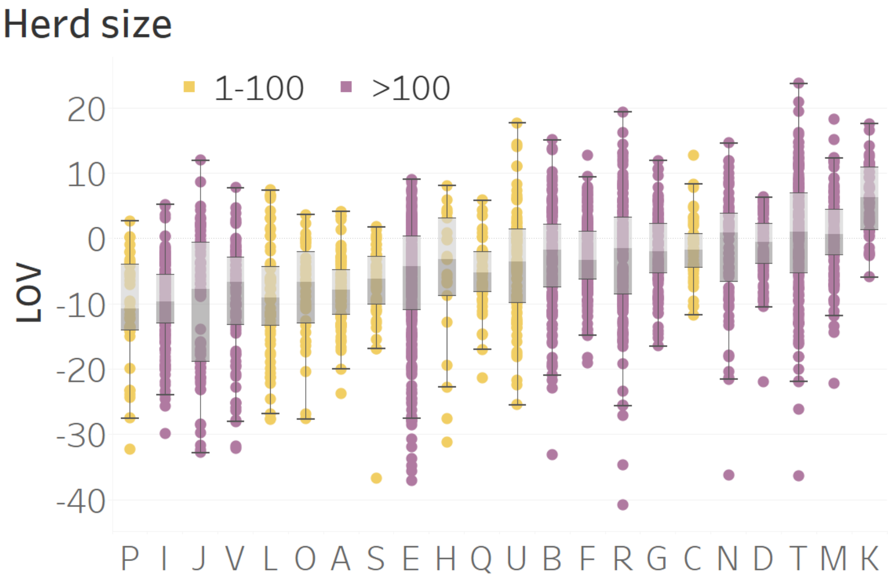

Figure 3: The distribution of herd size over the farms with calculated LOV's. The colour distribution shows if a farm has 1-100 cows (yellow) or over a hundred (purple).

Claw care

To visualize claw care management, the farmers were asked how many times a year hoofs were trimmed, within and outside a cows lactation cycle. Most farmers (61.1%) used the dry off moment as a fixed moment to trim. For each farm the total frequency was calculated (Figure 4). Hoof trimming occurred one or two times a year at most farms (89.5% BE; 64.7% NL).

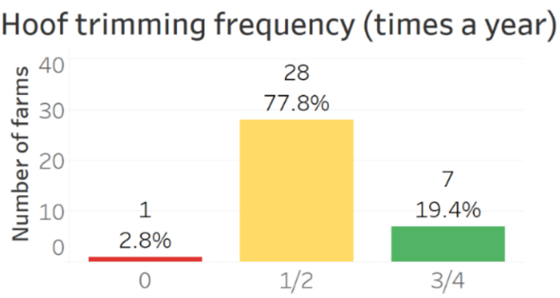

Figure 4: Hoof trimming frequency per year of all 36 farms

LOV - Claw care

The group of high frequency trimmers was small (n=4), but belonged for 75% to the lowest 50% scoring farms. The means of the LOV's from the low frequent trimmers (1-2 times a year, n=17) and the high frequent trimmers (3-4 times a year, n=4) were -4.6 and -6.8 respectively. Although the high frequent trimmers had a more negative LOV, it was not a significant difference (P = 0.24). The farmers who trimmed at the dry off moment seemed to have a better LOV than the farmers who did not have a fixed moment. Again, this was not significant (P = 0.3)

Dry off

Questions were asked about drying off method, duration of the dry off period, and measures to reduce milk production prior to the dry off moment. There were two questions about the body condition score (BCS). As most of the farmers did not monitor a BCS in general and could not answer these questions properly, this information has not been used.

Most farmers (Dutch as well as Flemish) chose the cows' dry off moment based on calving date over a fixed moment in time (+/- 70%). Each time two to three cows were dried off in more than 70% of the responses. In the Netherlands, the median dry period (47 days) was much longer compared with the 42 days in Belgium (Figure 5). Additionally, the Dutch dairy farms showed a larger range in total days.

The respondents were asked if internal teat sealers (TS) were used at dry off and to what extent

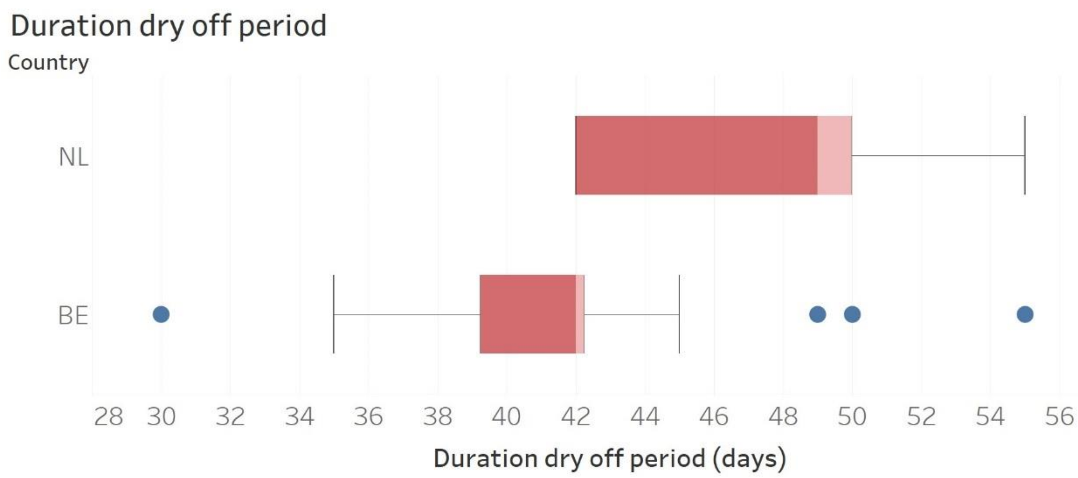

Figure 5: Box-and-whisker plot of the duration of the dry off period in days for the Dutch and Flemish farms. The minimum of the Dutch responses was the same as Q1. All Dutch responses fell in the range of the boxplot, in contrast to four Flemish responses

antibiotics were used (all animals, some animals or no animals), and if they used a barrier teat dip (BTD). The use of TS was common at the Dutch and the Flemish farms (82.4% and 89.5% respectively). The dry off methods used by farmers differed between the two countries in the use of antibiotics (AB) and barrier teat dips (BTD). In the Netherlands, most farmers (82.4%) only treated cows with a high somatic cell count (SCC) with AB at drying off. At two Dutch farms there was no AB use at all. The selective use of AB was not common in Belgium, illustrated by 79% of the farmers who were treating all cows at dry off with AB.

44.4% of all respondents were using BTD's (52.9% NL; 36.8% BE). Of all 34 farmers who did use AB, 47.1% used a BTD as well: 60% in case of the Dutch farmers and 36.8% of the Flemish. No associations were found between the different dry off methods and LOV's of the farms.

There was a notable difference in maximum production at drying off between the two countries (Figure 6). The Dutch farmers dried off at a lower maximum (10-20 kg a day) production compared with the Flemish (15-35 kg a day). In line with that, almost all of the Dutch farmers (94.1%) took measures to reduce milk production before dry off, while some Flemish farmers (21.1%) never did. The choice pattern in which measures were taken was similar in both countries (Figure 7). The reduction in concentrates fed however, was a measure more Dutch farmers took.

LOV - Dry off

The difference in maximal daily production at dry off did not show an associative pattern with the LOV. In contrast, there seemed to be a difference in level of LOV between farmers who

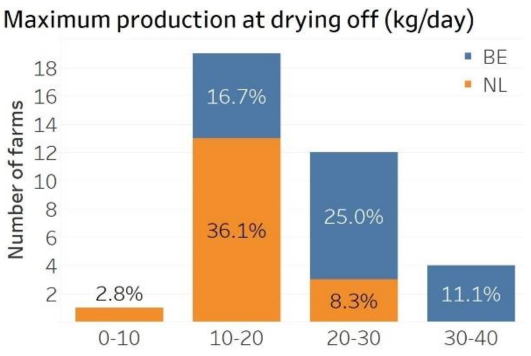

Figure 6: The maximal kilograms of milk production per day the respondents would dry off a cow at, categorized per 10 kg.

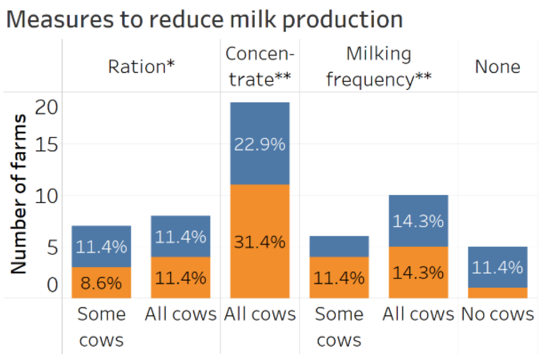

*Figure 7: The distribution of responses which measures the farmers took to reduce milk production pre drying off. *alteration, **reduction.*

took measures to all cows to reduce milk production versus farmers who took measures to some, as the former group seemed to score higher than the latter (Figure 8). This difference was found to be significant ($P = 0.048$). Nevertheless the group was very small (n = 4) and when the farmers who never took measures were included in the latter group the significance disappeared ($P = 0.213$).

Housing

All participating Dutch farms had a cubicle housing system. The Flemish farms were divided between cubicle housing, straw barns or a combination (47.4%, 31.5% and 21.1% respectively). All Dutch farms and 89.5% of the Flemish farms had headlock barriers as a system for feeding at the bunk. Only two Flemish farms (10.5%) used a post-and-rail system.

On 19 of the 36 participating farms, all dry cows were housed in one group (52.8%). The remaining 17 farmers separated their dry cows in a Far-off (FO) and Close-up (CU) group

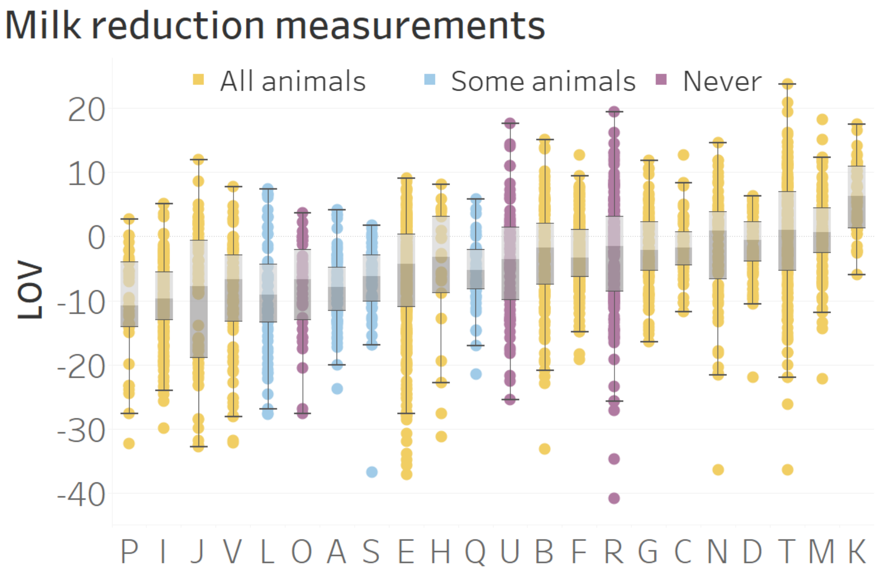

Figure 8: The farms with their calculated LOV's. The colour distribution shows if a farm took measures to reduce daily milk production for all animals (yellow), some animals (blue) or no animals (purple).

(47.2%). The distribution of the two countries was similar in the responses.
Each dry-off group (one group/FO-group/CU-group) was housed in one pen on 86.1% of the farms. The remaining farms, of which three had straw barns and two had cubicles, the number of pens ranged from 2-4. At all farms recently dried off cows were added to a group, so no farmer kept groups separated.

The length of the far-off period differed between the farms. Most farms' FO-periods (78.6%) ranged between 50 and 75% of the total length of the dry period (Figure 9). All Dutch farms were in this range, in contrast to the Flemish.
The amount of dry of groups (one versus two) and the differences in length of the FO-period did not show a possible association with the LOV.

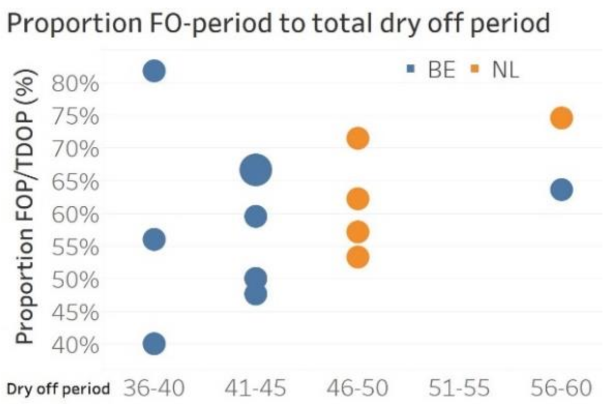

Figure 9: The proportional far-off period (y) on each farm, as a percentage of the total far-off period (x) for each farm (dot). The large dot represents two farms.

The majority of the farmers (86.1%) moved their heifers into the herd pre calving. 47.2% moved them into the dry cow group and 38.9% into the lactating group. A difference was seen between the countries, as most Dutch farmers added them to the dry cow group (58.8% compared with 29.4% to the lactating group), while more Flemish farmers choose the lactating group (47.4% versus 36.8% to the dry cow group).

Figure 10 shows the distribution pattern of these groups over the calculated LOV's of the farms. The farmers adding the heifers to the lactating group seemed to be the farmers with a better LOV: 87.5% of this group of farmers were represented in the best 50% of the farms with an LOV (Figure 10), compared with only 40% of the farmers adding the heifers between the dry cows. The mean LOV's of the two groups differed and had a tendency for significance (P = 0.05131).

Nine farmers had a 'fresh cow group' on their farm (25%). On five farms (55.6%), these are cows that will be kept separately for just 1 to 2.5 days. Two farms (22.2%) kept their fresh cows separate for one week. The other two kept them in a fresh group for a longer period (14 and 30 days).

70.6% of the Dutch farms had no outdoor access for the dry cows, 11.8% had them walking on fertilized pasture, a same percentage had outdoor access but no pasture and one farm (5.9%) had unfertilized pasture. The Dutch farms with one dry off group showed a distribution over the four different responses, but 87.5% of the 8 farms with two dry off groups had no outdoor access for both groups.
The Flemish farms had more outdoor access for the dry cows as 50% of the respondents chose 'no outdoor access'. In contrast with the Dutch farms with two groups, there was a difference in outdoor access between the FO and CU-group, as 88.9% of the farms had outdoor access for the FO-group, and not for the CU-group. 55.6% of those FO-groups had access to unfertilized

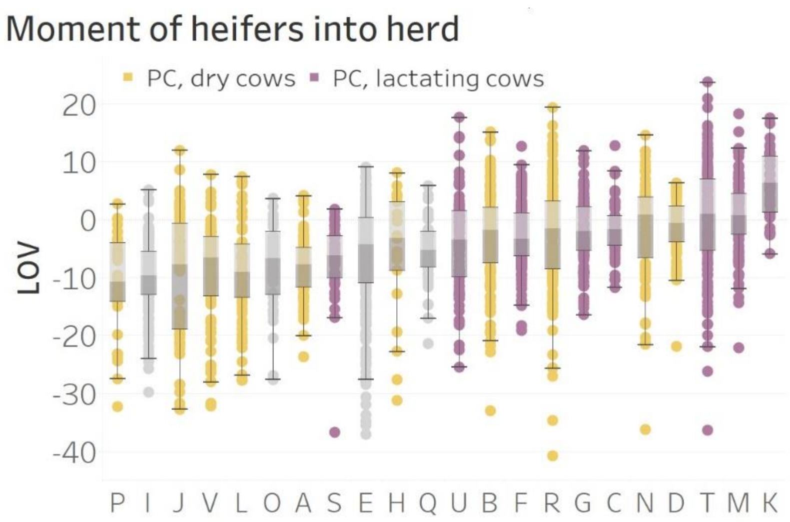

Figure 10: The farms with their calculated LOV's. The colour distribution shows if the farmer added the heifers pre calving (PC) to the dry cow group (yellow) or the lactating group (purple). Farmers of the grey coloured farms chose different answers.

pasture, the remaining farms were evenly divided between fertilized pasture, no pasture and no outdoor access.
For the lactating cows there was access to fertilized pasture in 77.8% of the farms, 2.8% to unfertilized pasture and 19.4% had no outdoor access. 88.9% of the farms with a fresh cow group kept them inside. For the lactating and fresh cows there was no difference in choice pattern between the Dutch and Flemish responses.
No association was found between outdoor access and the LOV.

The amount of headlock barriers and cubicles was analyzed by the proportion of these to the total herd size. This was done for the lactating cows and the dry cows (Figure 11 and 12). The farms with over 100% of headlock barriers and cubicles were categorized as ‘enough’, between 90 and 100% were labeled as ‘unclear’ and beneath the 90% were ‘not enough’. Notable was that most farmers did not have enough space at the feeding bunk for lactating cows (59.4%) and only 15.6% clearly did. The dry cows on the other hand had enough feeding space in 84.4% of the cases (Figure 12).

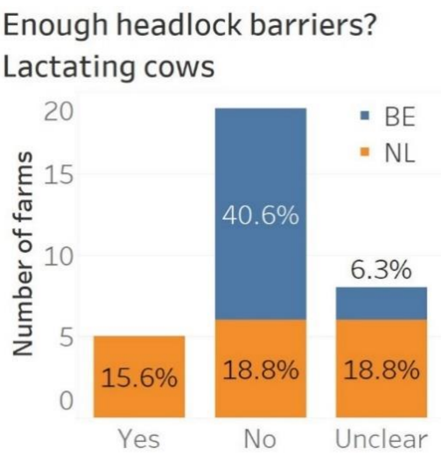

Figure 11: Number and percentages of farms that did or did not *have enough headlock barriers for their lactating cows and for which it* was not *clear*

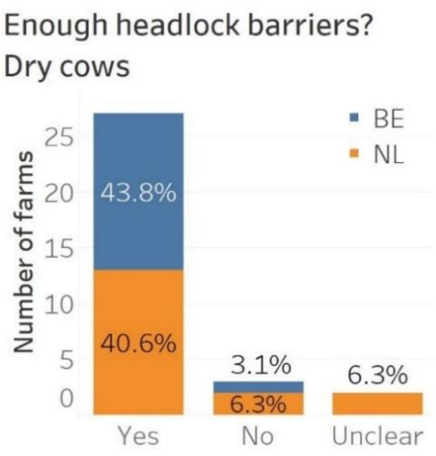

Figure 12: Number and percentages of farms that did or did not *have enough headlock barriers for their lactating cows and for which it* was not *clear.*

A similar scenario applied to the amount of cubicles: while most farms provided enough resting space for the dry cows (81.5%), only 30% did for the lactating cows, while 53.4% did not.

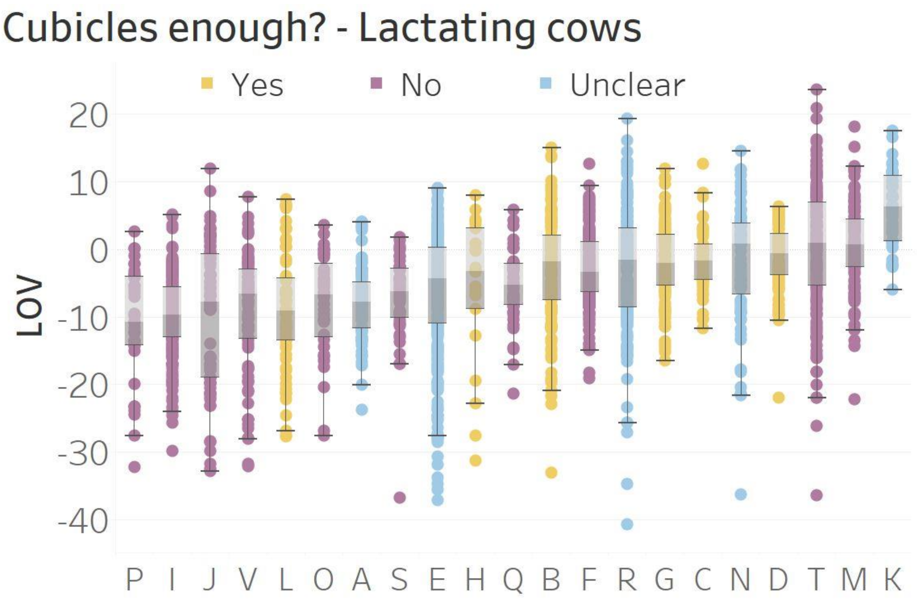

Figure 13: The farms with their calculated LOV's. The colour distribution shows if the farm had enough cubicles for the lactating group (yellow), if it had not *enough (purple), or if it was unclear (blue). Farm ID 'U'* did not *have cubicles and was excluded in this figure*

The overstocking according to the number of spots at the feed bunk did not seem to be negatively associated with the LOV. On the contrary, four farms with a lack of cubicles for the lactating group were the farms with the lowest mean LOV (Figure 13). As the figure shows, 70% of the farms with this overcrowding was represented in the eleven lowest scoring farms, while two third of the farms with enough cubicles were represented in the eleven highest scoring farms. Although the difference in means was not significant (P = 0.1857), overstocking could be a problem for the fresh cows in the lactating herd which might explain this trend.

Housing – Lying comfort

Based on the results above, dry cows might be more comfortable than fresh cows housed within the lactating group. As comfortable rest periods are important for the transition cow, questions were asked in the survey about the lying and standing behaviour of the dry and lactating cows as indicators for the lying comfort in the cubicles. For each group, the farmers could determine the frequency of seeing cows in the positions showed in Figure 14 and 15. The frequency options were 'rarely or never', 'regularly' and 'often'.

Figure 14: A diagonally lying cow in a cubicle. A cow lying like this could imply the cucible is too short to lie down straight

Figure 15: Cows standing in cubicles. A cow standing like this could imply the cucible is not comfortable enough to lie down.

A striking difference between the Dutch and Flemish farms was that a big proportion of the Flemish farms were housing the dry cows, the CU-group in particular, on bedded packing instead of cubicles (Figure 16). Based on the lying posture, the Flemish cows would have a better lying comfort than the Dutch (Figure 16 and 17) as only 22.2% of the FO-cows were occasionally seen like that, and the rest seldom or never. Most of the Dutch farmers (around 75%) also rarely saw their dry cows lie down like that, but especially in the FO -group the cows were regularly seen lying like that (Figure 17). In both countries, the lactating cows had worse lying comfort in comparison with
the dry cows.

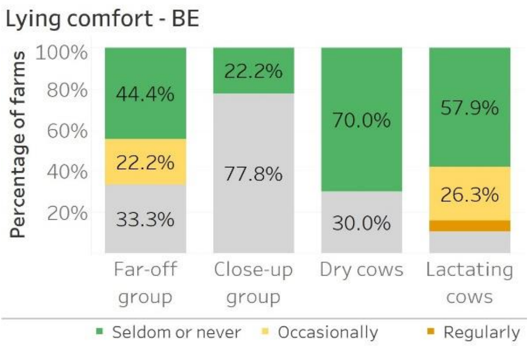

Figure 16: Percentages of responses to the frequency Flemish farmers saw cows lie down like the cow in Figure 14. The grey areas show the farms that don't have cubicles

Figure 17: Percentages of responses to the frequency Dutch farmers saw cows lie down like the cow in Figure 14.

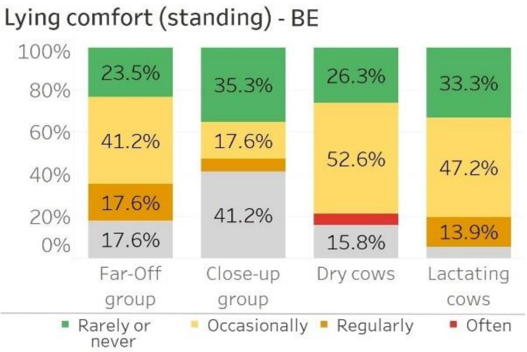

Figure 18: Percentages of responses to the frequency Flemish farmers saw cows standing like the cows in Figure 15. The grey areas show the farms that don't have cubicles.

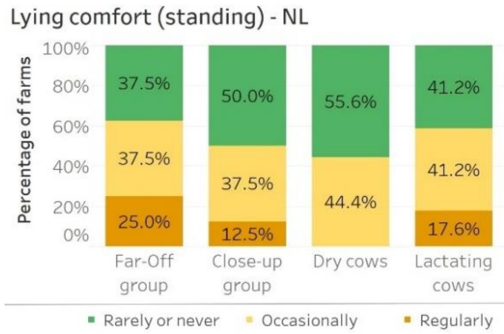

Figure 19: Percentages of responses to the frequency Dutch farmers saw cows standing like the cows in Figure 15.

In general, the dry cows on cubicles had similar lying comfort compared to the lactating cows (Figure 18 and 19). Notable was that Dutch farms seemed to have better lying comfort for the different groups of cows compared with the Flemish, except for the CU-group. In Belgium, the dry cows housed in one group had the worst lying comfort, in contrast with The Netherlands, where the dry cows within one group seemed to have the best lying comfort.

LOV – Housing – Lying comfort

No association was found between the frequency farmers saw the lactating cows lie down in the diagonal posture and their LOV's. Among the farms with calculated LOV's there were too few farms with a 'high' frequency of seeing the dry cows lie down like that to notice associations (n = 2). The same applied to the dry cows in standing position (Figure 15, 18 and 19). Although the lactating group did not have the worst lying comfort based on standing behaviour, there seemed to be an association with the LOV, as the farms with seldom or never as a response were more represented at the side with the more positive LOV's (right) in Figure 20. This difference however was not significant (P = 0.303).

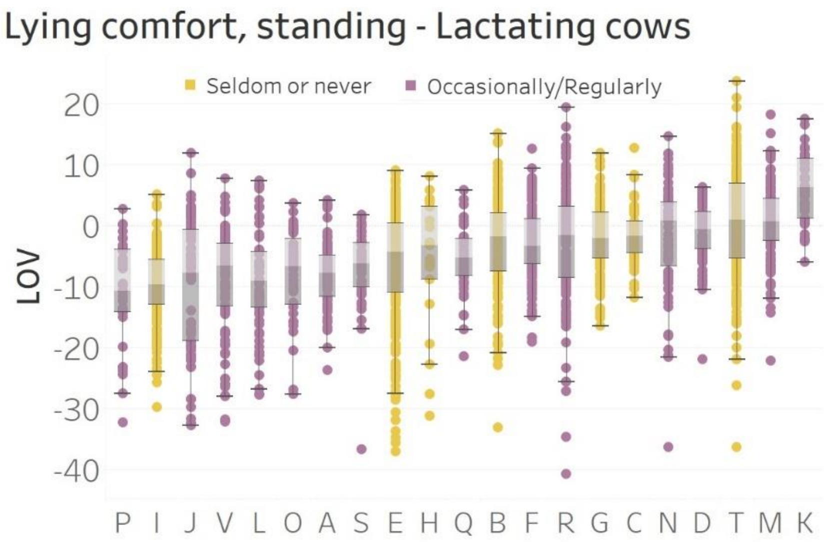

Figure 20: The farms with their calculated LOV's. The colour distribution shows if the farmer seldomly or never (yellow) saw the lactating cows standing in their cubicles, or occasionally/regularly (purple). Farm 'U' was excluded, because it did not *have cubicles.*

Housing – Heat measures

As heat stress could have an impact on the transition of cows, the extent to which the farmers took measures against it was evaluated. For each group (dry, FO, CU, lactating or fresh cows) four types of measures could be chosen (continuous shadow, ventilation, sprinklers and roof isolation). A hypothesis was that more measures would be taken for the lactating cows compared with dry cows, which appeared to be true for the amount of measures, the installation of fans and sprinklers.

In case of the dry cows, 52.8% of the farmers took more than one heat measure versus 44.4% that took one measure, with a similar distribution pattern between the two countries. For the lactating cows the difference between the farms was bigger: 58.3% took more than one measure against heat stress, while 33.3% took one measure and 8.3% did nothing.

The dry cows had continuously access to shadow at 94.4% of all farms. The lactating cows had this at 75% of the farms. This was mainly due to 47.% of the Dutch farmers who did not provide continuous shadow.

Most farmers (72.2%) did not have fans for their dry cows, while the distribution was almost 50-50 in case of the lactating cows. Five Dutch farmers (29.4%) had installed fans at the lactating cows but had not at the dry cows.
Most farmers did not have roof isolation for their dry cows (63.9%), or lactating cows (66.7%). Relatively more Dutch farmers had roof isolation than Flemish, with 20.8% more in case of the dry cows and 37.1% with the lactating cows.
Only 13.9% of the total number of farms had sprinklers in heat periods for the lactating cows. The distribution was similar for both countries.

88.9% of the farms with a separate group for the fresh cows took more than one measure against heat stress. The same percentage had continuous shadow for these cows. On 55.5% of the farms the fresh cows had fans and the same percentage had roof isolation. In all these variables the distribution of the both countries was similar, except for roof isolation: most of the Dutch farmers (75%) with a fresh cow group had roof isolation for these cows, while most of the Flemish (60%) did not.

LOV – Housing – Heat measures

The five best scoring farms on the LOV were all taking more than one measure against heat stress for their dry cows (Figure 21). However the difference between taking more than one measure versus 0-1 and the LOV only tended to be significant (P = 0.5498). In case of the lactating cows the colour pattern was more evenly distributed.

Farms which had no continuous shadow for the lactating cows were still for 71.4% among the 11 best scoring farms, implying other factors than the access to shadow was of greater importance for a successful transition on these farms. In case of the dry cows the group that did not have access to shadow was too small to make an association (n = 2).

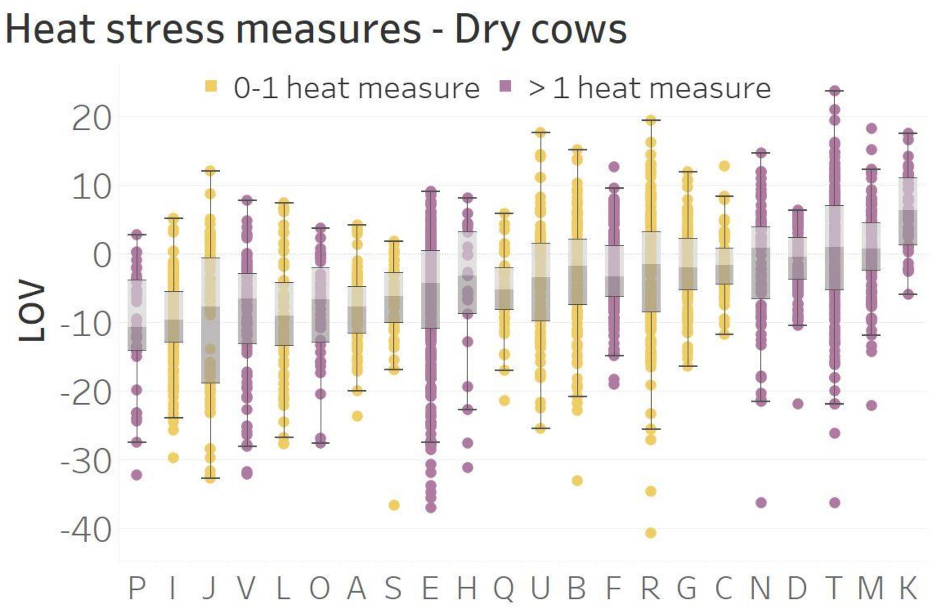

Figure 21: The farms with their calculated LOV's. The colour distribution shows if the farmer took 0-1 measures against heat stress (yellow) or more than one measure (purple) for the dry cows.

There was no association between the farms with roof isolation for the dry cows and the LOV score, but there seemed to be for the lactating cows: 71.4% of this group was among the eleven highest scoring farms, against 40% of the farm without roof isolation. However, the difference in mean LOV's of both groups was not significant (P = 0.401).

Differences in housing FO and CU-group.

As mentioned before, 89.5% of the farmers housed their dry cows in two groups (FO and CU). Differences in housing between the FO and CU-groups were seen in type of pen, to the extent of outside excess and in the standing frequency in the cubicles.

A small percentage of the farmers with two groups (23.5%) housed their FO-cows on cubicles and their CU-group at a straw barn. These were all Flemish, as all the Dutch farmers housed their cows on cubicles. The remaining percentage (76.5%) had the same housing system for both groups. Most farmers (88.2%) kept their CU-group inside, while a small majority (52.9%) of the farms had outside access for their FO-group.

On 70.6% of the farms there was no difference in lying comfort between the two groups, based on the lying posture of the cow in Figure 15. For the standing posture this percentage was 52.9%, meaning more different frequencies were seen between the two groups. The CU-cows were seldom or never seen in this posture by 60% of the farmers, while this was only 28.5% for the FO-cows. Most farmers (50%) saw their FO-cows occasionally standing like that, which could imply the CU-cows were slightly more eager to lie down due to a more comfortable underground in these cases.

Most farmers (82.4%) took the same amount of heat measures for both groups (0-1 versus >1). At the remaining three farms more heat measures were taken for the CU-group. There was no striking difference in which measures were taken between the two groups.

Calving

Figure 22 shows the proportion of calvings relative to the herd size. Eight out of the 36 farmers in total filled in the same number of calvings as their total number of cows, as the grey line shows in the figure. These farms were not considered in the analysis. There is a difference between the Netherlands and Belgium: relative more Flemish farmers did have more calvings than cows (25% vs 11.1%) and relative more Dutch farmers had less calvings than cows on their farm (25% vs. 16.7%).

Another difference between the two countries was the calving pattern. 89.5% of the Flemish farmers had a uniform pattern during the year, while the Dutch responses were more equally divided between a uniform pattern (47.1%) and a seasonal pattern (52.9%).

On almost all Dutch farms heifers and cows (94.1%) calved in a calving pen; on only one farm both cows and heifers calved between the dry cows. The Flemish answers were more divided: on 57.9% of the farms heifers and cows calved in a calving pen, on 21.1% both groups calved among the dry cows, on 10.5% of the farms the heifers calved in a calving pen and the cows calved between the dry cows. On the two remaining farms the heifers calved between the

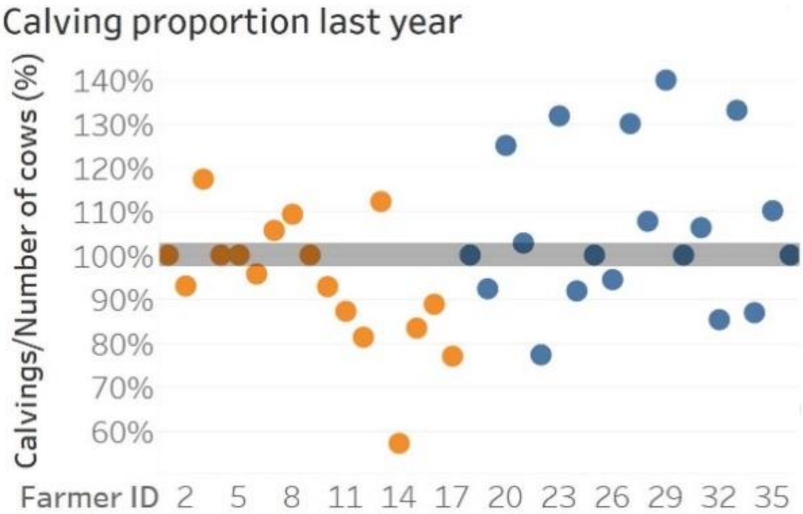

Figure 22: Percentages of calvings relative to the total number of cows on each farm. Each dot represents a farm, Dutch (orange) or Flemish (blue)

lactating cows, while the cows calved between the dry cows (5.3%) or in a calving pen (5.3%). 50% of all the respondents used their calving pen also as a pen for sick cows. Among them was 41.2% of the Dutch farmers and 57.9% of the Flemish.

The period heifers and cows were housed in a calving pen was calculated by the sum of the days housed in the pen before and after calving, which the farmers answered to the survey. On most farms this was a period between half (0) and two days (Figure 23 and 24), which was similar for heifers and cows (44.4% and 41.7% respectively).
The differences between the heifers and the older cows were not big, the most notable difference between both figures were some Flemish farmers who kept heifers longer (5-7 days) in the calving pen than the older cows (3-4 days).

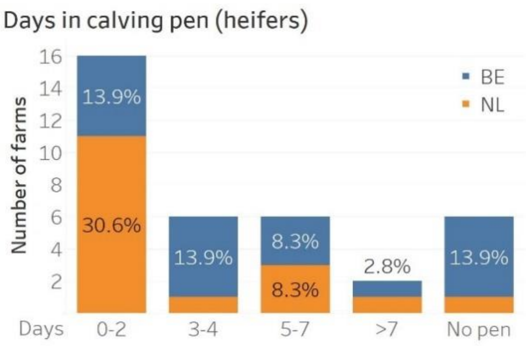

Figure 23: The total period in days heifers were in the calving pen around calving.

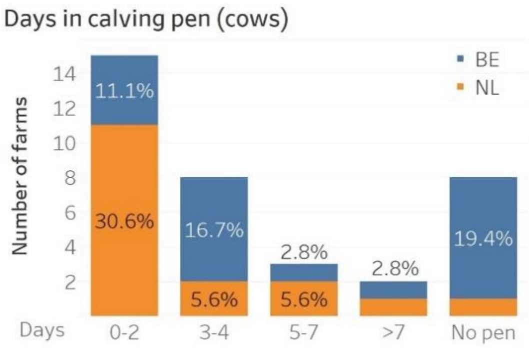

Figure 24: The total period in days cows were in the calving pen around calving

The median of the periods was higher in the Flemish responses than the Dutch responses (Figure 25), for both heifers (2.8 vs 1.8) and cows (3 vs 2), but the Dutch responses had a wider range.

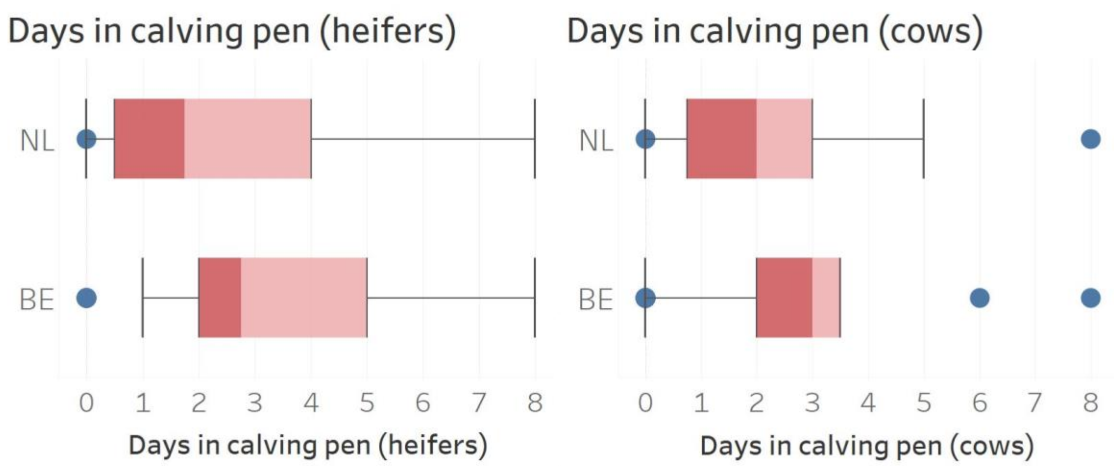

Figure 25: Box-and-whisker plots for the length of housing in a calving pen for heifers and cows on farms from the Dutch and Flemish nationalities.

LOV - Calving

There was an association between the amount of calvings on a farm and the mean LOV.
Of the 22 farms with a calculated LOV, 50% had over a 100 calvings a year, the other 50% 1-100. The farms with over a hundred calvings a year formed 72.7% of the eleven best scoring farms (Figure 26). When the proportion of calvings in relation with the total number of cows on the farm was taken into account, the association between many calvings and a better LOV became even more clear: 83.3% (5/6) of the farms with a calving proportion (number of calvings/number of cows) higher than 100% belonged to the 50% highest scoring farms. The difference found between the mean LOV's of the two groups was significant (P = 0.022).

There seemed to be an association between calving pattern and the LOV: 75% of the farms with a concentrated calving pattern (6/8) were among the best scoring 50% of the farms, compared with only 35.7% of the farms with a uniform calving pattern (Figure 27). Unfortunately this difference was not translated to any significance (P = 0.3).

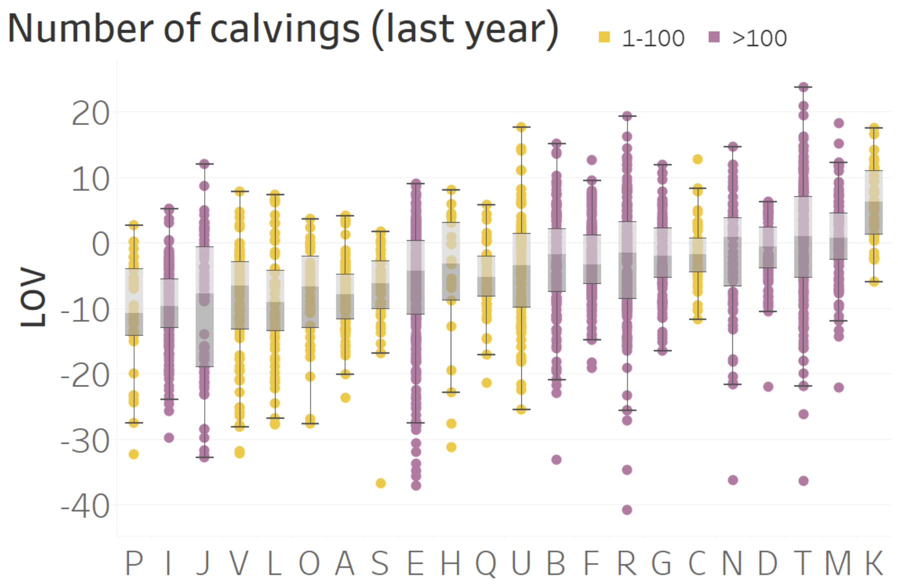

Figure 26: The farms with their calculated LOV's. The colour distribution shows if the farm had hundred or less calvings last year (yellow) or more than hundred (purple).

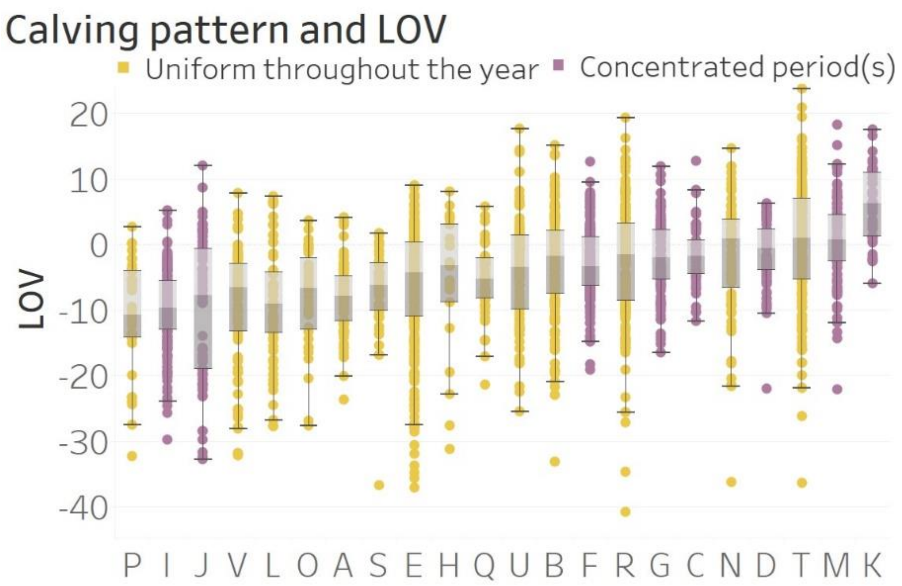

Figure 27: The farms with their calculated LOV's. The colour distribution shows if the farm had a uniform calving pattern (yellow) or concentrated period(s) (purple).

A long period in the calving pen (>2 days) versus a short period in the calving pen (0-2 days) did not show an association with the LOV in case of the heifers, but there seemed to be one in case of the cows (Figure 28). Most of the farms (66.7%, n = 7) with the cows in the calving pen for three days or longer were farms within the 50% lowest scoring farms. Only one third of the 12 farmers who kept their cows for a maximum of two days were in this group. Two of the three farms without a calving pen also belonged to this group. Thus, a shorter period in a calving pen might give better transition results. The difference in means between the two groups however, were not significant (P = 0.17).

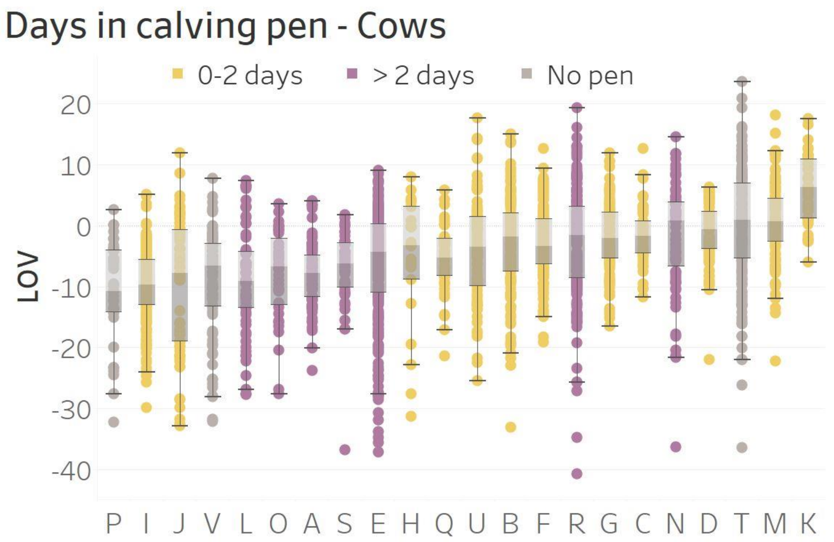

Figure 28: The farms with their calculated LOV's. The colour distribution shows if the cows on the farm stayed in the calving pen for zero to two days around calving (yellow) or for longer than two days (purple).

Nutrition

Most farmers fed the same basic ration during the whole dry off period (76.5% and 84.2% for Dutch and Flemish farmers respectively). Only 7 out of all 36 farmers (19.4%) did feed two different basic rations during dry off: a far-off ration and a close- up ration. As most of the farmers had one dry off ration group, features about this will be discussed and differences between the farmers feeding one ration versus two rations will be mentioned. After that, the differences between the far-off and close-up rations will be presented. Only 4 of the 22 farms with a calculated LOV fed two different rations during the dry off period. 75% of them were among the 50% lowest scoring farms. This was seen in a significant lower LOV for the two-ration farms compared with the one-ration (P = 0.009) but the group is very small.

75% of the farmers based their dry cow ration on a feed analysis, with a larger proportion Dutch farmers than Flemish (82.4% versus 68.4% respectively).
Remarkable was the difference in composition of the basic ration for the dry cows between the two countries. Most Dutch farmers (92.3%) fed grassland products and no straw (61.5%). Only 43.8% of the Flemish farmers fed grass land products and almost 70% did feed straw.

All farmers, with just one exception, fed dry cow minerals during the dry period. Of the farmers feeding one ration, 27.5% fed anionic salts. Only one farmer with an FO-ration (14.3%) and two with a CU-ration (28.6%) fed them to those groups. Except for two Dutch farmers within the one ration group (6.9%), no one fed calcium binders at their dry cows.

Most farmers (around 80%) fed no remnants of the lactating cows to the dry cows. Country or number of dry off groups did not have any influence. Three out of the four farmers who fed remnants of the milking cows to the dry cows were in the best scoring 50% of the farms with an LOV, but the difference was not significant.

75.8% of the farmers fed their cows extra concentrate in the last three weeks of gestation. A lower percentage of farmers with two dry off ration groups did the same: 57.2% (4 out of 7 farmers) fed more concentrate to the CU-group compared with the FO-group. Two farmers fed the same amount and only one farmer fed less concentrate to the CU-group. No association was found between the feeding of extra concentrate and the LOV.

In summer, the frequency of feeding fresh feed to the dry off group was higher than in winter; 51.7% of the farmers with one dry off ration were feeding a fresh ration in summer daily, compared with 34.5% in winter. Most farmers in this group (48.3%) were feeding every two days in winter.
Among the group of farmers feeding two rations during the dry period this difference was more obvious: 78.6% fed their dry cows daily in summer, compared with (50%) in winter. There was not an association between the frequency of feeding in winter and the LOV, but there seemed to be between the frequency in summer and the LOV, as will be discussed at the LOV – nutrition paragraph.

48.3% of the 'same ration' farmers pushed the feed to the bunk 3-4 times a day, 31% did this 1 or 2 times a day. The remaining 20.7% pushed more than 4 times, by themselves or with a robot. Although among these first two groups there was not a notable difference between the two countries, 5 out of the 6 farmers pushing more than 4 times were Flemish. The 'two ration farmers' were also mostly distributed over the 1-2 and 3-4 frequency, with a slight difference between the two groups, as described later in this paragraph. Although four out of the five best scoring farmers were all pushing feed to the bunk more than 4 times a day, an associative colour pattern was not seen over the LOV figure that's been used for every variable (e.g. Figures 26-28).

To indicate how many remnants of feed were at the bunk just before feeding, the respondents could compare their situation to the pictures in Figure 29. Most farmers (58.3%) chose Picture 2, in which some food is still there, followed by Picture 1 (38.9%), in which the floor was clean. The choice pattern between the two countries was similar, but there were differences in choice pattern between farmers with one dry cow ration group versus two groups. Picture two was more frequently chosen among the dry cow group with one ration (58.6%) compared with

Picture 1 (31%), while farmers with two rations were evenly distributed between Picture 1 and 2. There was no association between the amounts of residual feed and the LOV.

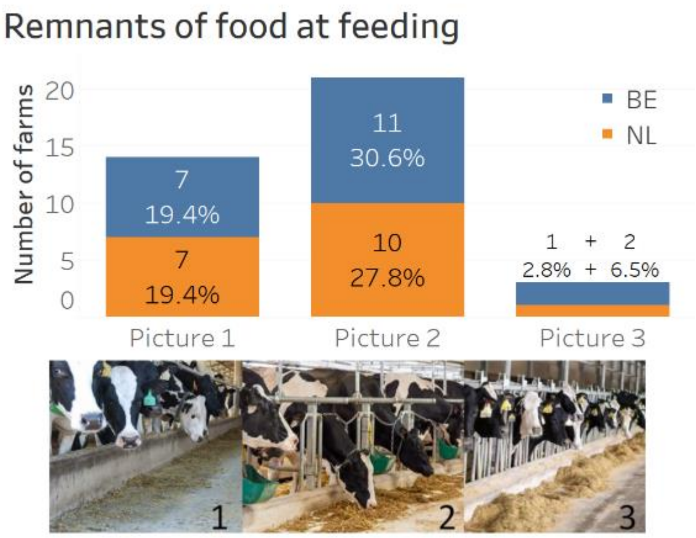

Figure 29: amount of food remnants present at feeding. The numbers in the pictures correspond with the responses in the bar chart.

LOV – Nutrition

The six farmers who did not carry out feed analysis on the dry cow rations were for 66.7% represented in the 50% lowest scoring farms. There was not a significant difference between the LOV's of the groups that did or did not (P = 0.19).

The feeding of straw did not seem to be associated with the LOV. Farms feeding grassland products were almost evenly distributed over the low and high scoring 50% of the farms. However, 66.7% (4/6) of the farms not feeding grassland products were among the best scoring 50% (Figure 30). As the mean LOV of this last group was -3.4 and the mean LOV of the group feeding grass land products was -5.9, it seemed the farms not feeding grassland products were more successful with their transition. Nevertheless, this difference was not significant (P = 0.16).

The farms feeding the dry off cows with a lower frequency in summer were not associated with lower LOV's. On the contrary, 71.4% of these farmers were among the eleven highest scoring farms, although no one was among the best five (Figure 31). Both groups did not differ significantly in their LOV's (P = 0.5079).

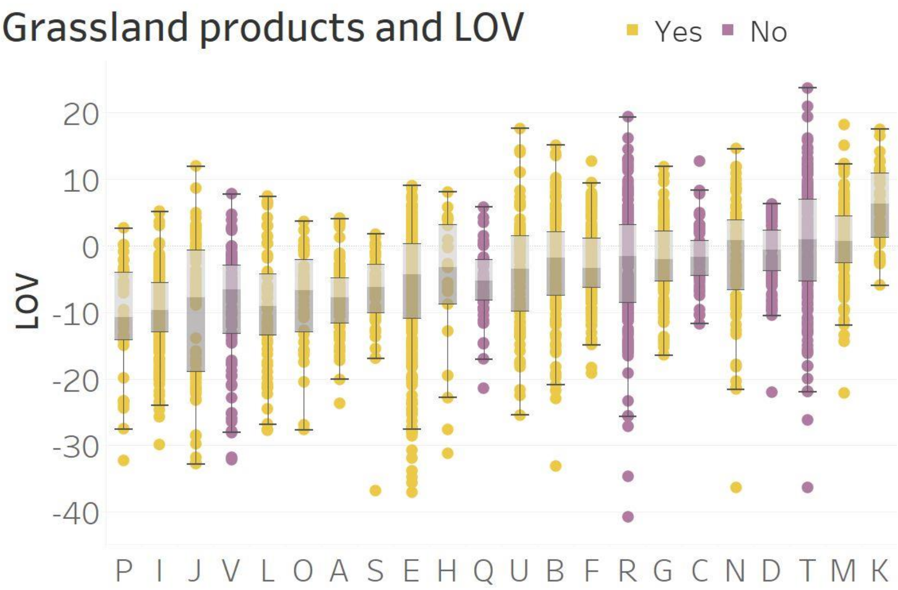

Figure 30: The farms with their calculated LOV's. The colour distribution shows if the farm fed grassland products to the dry cows (yellow) or did not *(purple).*

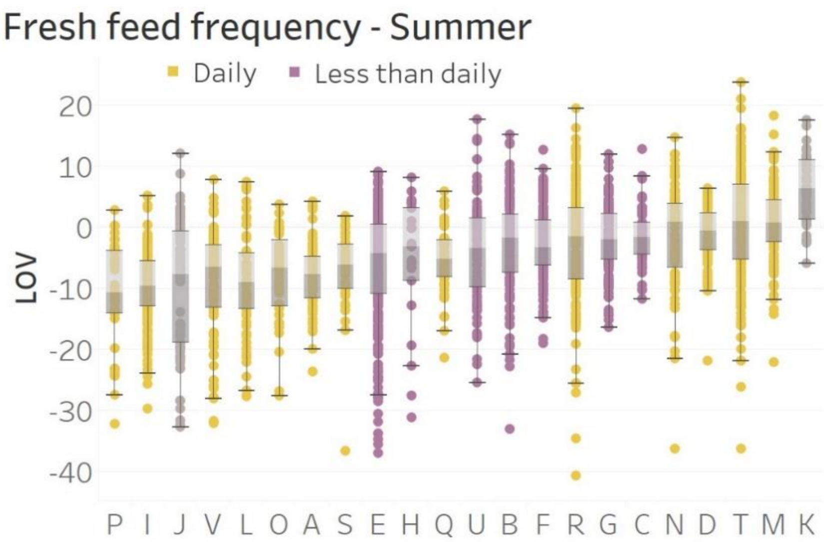

Figure 31: The farms with their calculated LOV's. The colour distribution shows if the farm the dry cows daily (yellow) or less than daily (purple). The two grey coloured farms were feeding the FO-group less than daily and the CU-group daily.

FO and CU ration – differences and similarities

As mentioned before, seven farmers were feeding different rations to their FO and CU-group. There were a few aspects that differed between the two groups on several farms.

The biggest difference between the two rations was the energy density. All of the farmers fed a higher energy dense ration to the CU-group than the FO-group.

Another difference between the two rations was that 42.9% (3/7) fed remnants of the lactating ration to their FO-group, but did not to their CU-group.
There was also a difference in the feeding of extra concentrates in the last period: 4 farmers (57.2%) fed more concentrate to their CU cows compared with the FO cows. Two farmers gave the same amount and one farmer fed his FO-group less concentrate in comparison with the CU-group.

The last difference between the two rations was found in the fresh feeding frequency: 42.9% (winter) and 57.1% (summer) of the farmers fed their CU cows more frequently than their FO cows. In winter these farmers fed the FO-group every two days and the CU-group daily. In summer two farmers handled the same difference in frequency, one farmer fed the FO cows less than every two days and the CU-group daily and the last one fed the FO-group once a day and the CU-group multiple times a day.

All farmers with two groups that did a feed analysis (85.8%), did this for both groups.
The choices in feeding straw or grassland were similar between the two groups at most farms. Only one farmer was not feeding straw to the far-off group and started feeding chopped straw in the close-up group. The six other farms were for both rations divided equally over the groups that fed no straw, chopped straw and straw that was not chopped. The two feeding groups also did not differ in the feeding of grassland products.

At five farms (71.4%) the amount of remnants at feeding was similar between the far-off and close-up group. The same percentage did not have a difference in pushing frequency of the feed for both groups. The remaining two farms pushed the feed to the bunk once a day more. 85.7% of the farmers fed the same products (dry cow minerals or anionic salts) to their FO as their CU-group. Only one farmer switched from feeding dry cow minerals to the FO cows to feeding anionic salts to the CU cows.

Follow up

To gather information about farmers' follow up methods for recently calved cows, eight types of measurements were presented in the questionnaire. For each method the frequency of application had to be picked, choosing from 'daily', 'less than daily', 'only animals at risk' and 'never'. A categorization of these responses was made based on a 'follow-up score'. Farmers could score a maximum of three points for each method, with more points for a higher frequency. The points were given for analytical purposes and were of no other value.

In general, the Flemish farmers had a higher follow up score than the Dutch farmers (Figure 32). 52.9% of the Dutch respondents had a score between 9 and 12 and most Flemish respondents scored between 13-16 (68.4%). The amount of dry off groups (housing) did not seem to have an impact on follow-up score. Eight out of the nine farms (88.9%) with a fresh cow group scored in the two highest categories. Most farms that did not have a fresh cow group belonged to the two middle categories (61.1%).

The 7 farmers that fed two different rations during dry off were represented in all four categories in similar amount. From the 13 farms with a milking robot, 92.3% had a follow up score in the two highest categories.

The measurements most commonly done at a daily base were taking a general impression (83.3%), monitoring milk production (86.1%) and checking on appetite (52.8%) and rumen fill

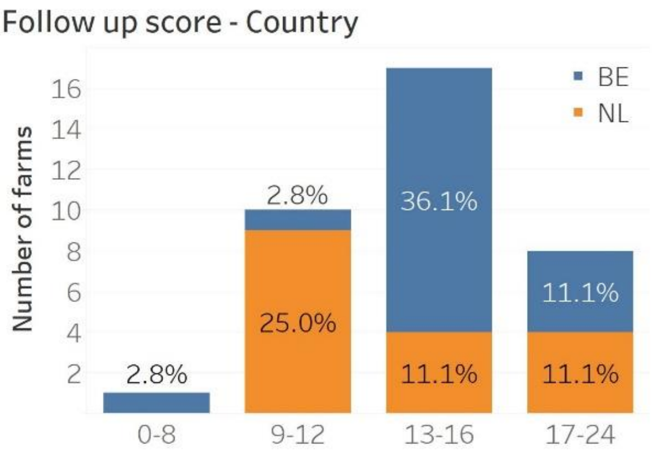

Figure 32: Bar chart of number and percentage of farms belonging to a class of follow up score. Points were assigned to the answers 'Daily' (3), 'Less then daily' (2) and 'Only animals at risk'(1)

(52.8%). Most farmers monitored temperature only with animals at risk (61.1%). The frequency of ketone testing was more divided between the respondents: most farmers never did a ketone test (41.7%), followed by 33.3% testing only animals at risk and 22.2% less than daily.
58.3% of the farmers never used cow sensors, but the 41.7% who did monitored them daily. Monitoring of milk measurements, like fat content or electrical conductivity, was never done by 47.2% of the farmers and was done daily by 30.6%.

The use of five products for the prevention of transition diseases were also recorded. The participating farmers were asked to choose the most fitting answer to which animals they gave a preventive treatment. The treatments were calcium supplementation, vitamin D injection, drenching, glucose or glucose precursors and Kexxtone® boluses. The possible answers were 'all cows', 'risk animals only', or 'none'. Again, a categorization of the farms was made based on a point system, ascending with an increasing number of animals, with a maximum of two points for each product. This resulted in a score for each farm between 0 and 10 points. Again, the amount of points was a method of analysing the answers, the points themself don't show a value in relationship with successful transition management.

The scores ranged from 0 to 6. In general, the Flemish farmers used more preventive products than the Dutch farmers (Figure 33). The farms with one dry off group were represented in every score, most farms with the dry cows housed in two different groups scored between 2 and 4 (88.2%). Farms with a fresh cow group were fairly evenly distributed between the scores 1-5. 5 out of the 7 farmers (71.4%) feeding two different dry off rations had a score of 2 or 3. This could imply less preventive measures were needed for the cows at these farms. The same might be true for the farms with two dry off groups mentioned before. Later in this paragraph these groups are compared using the prevalence of transition diseases like milk fever, ketosis and abomasal displacement.

80.6% of all the farmers treated animals at risk with calcium boluses or supplements, 8.3% treated all animals and 11.1% treated no animals at all. Most farmers (75%) did not use vitamin D injections, 25% only treated animals at risk. Similar were the responses on preventive drenching: 72.% of the farmers never drenched and 27.8% drenched animals at risk.
Glucose or glucose precursors were used as a preventive treatment for animals at risk on 50% of the farms. 22.2% of the farmers treated all animals, and 27.8% of the farmers never used this treatment. Most farmers (66.7%) gave Kexxtone® boluses to animals at risk, followed by 27.8% never using them and 5.5% giving them to all cows before calving.

Differences between the two countries were seen in the preventive use of calcium, drenching, glucose (precursors) and Kexxtone® boluses.

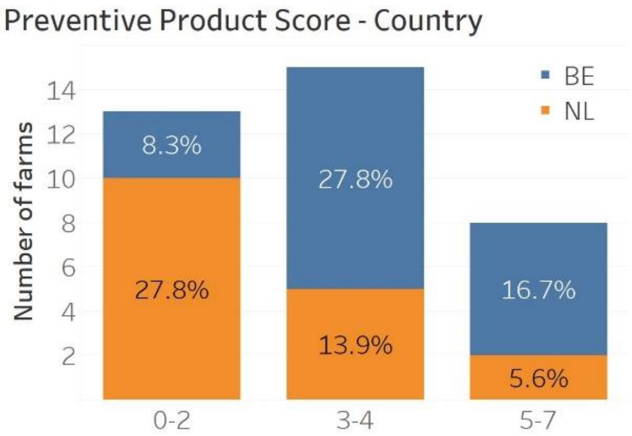

Figure 33: Bar chart of number and percentage of farms belonging to a class of the preventive product score. Points were assigned to the answers 'all cows'(2) and 'risk animals only'(1)

Calcium boluses or supplements were used for risk cows of almost 90% of the Flemish farmers, and 70.6% of the Dutch farmers. The remaining answers were divided evenly at 'none' or 'all animals' for both countries. Drenching was somewhat more common among the Flemish farmers, as 42.1% of them did it to animals at risk compared with 11.8% of the Dutch farmers. The same applied to the use of glucose (precursors): 68.4% of the Flemish farmers used it as a preventive treatment to animals at risk and even 26.3% of them at all animals. Most Dutch farmers did not treat any cow before calving (52.9%) and 29.4% treated animals at risk. Kexxtone boluses were by most Flemish farmers (78.9%) used in animals at risk. The Dutch responses were more evenly divided: 52.9% used them in animals at risk and 47.1% never used them.

The farmers were asked to fill in the clinical cases of hypocalcaemia, ketosis, mastitis, metritis, retained placental membranes and abomasal displacement in the last year. The prevalence of each disease on the farms was calculated by dividing the clinical cases by the total number of calvings in the last year. All the prevalences mentioned in this thesis are reported prevalences. The average prevalence of each disease was higher on the Flemish farms than on the Dutch farms (Table 1).

Table 1: Prevalences - Country

	BE	NL
Abomasal displacement	2.1%	1.5%
Hypocalcaemia (Milk fever)	6.5%	3.8%
Ketosis	11.9%	7.4%
Clinical mastitis	5.3%	1.9%
Metritis	5.0%	3.0%
Retained placental membranes	8.1%	4.1%

Table 2: Prev. - One or two dry off groups (FO/CU)

	One	Two
Abomasal displacement	2.4%	1.2%
Hypocalcaemia (Milk fever)	6.1%	4.3%
Ketosis	12.2%	7.0%
Clinical mastitis	4.4%	2.9%
Metritis	4.9%	3.1%
Retained placental membranes	6.2%	6.2%

Differences in disease prevalence between the farms with separate dry off groups versus one group were not very big (Table 2). In case of abomasal displacement, clinical mastitis, ketosis and metritis, the prevalence was lower on farms with separate dry off groups. The prevalence of milk fever and retained placental membranes however, was higher on the farms with one dry off group. In contrast, the Flemish prevalences were all clearly lower on the farms with separated dry off groups.

For all six diseases, the prevalences were lower at farms with a fresh cow group compared with farms without, except for clinical mastitis in the Flemish responses and hypocalcaemia in the Dutch responses (Table 3).

Table 3: Prev. - Fresh cow group on farm?

	Yes	No
Abomasal displacement	1.2%	2.0%
Hypocalcaemia (Milk fever)	4.0%	5.6%
Ketosis	7.3%	10.5%
Clinical mastitis	4.5%	3.4%
Metritis	3.2%	4.3%
Retained placental membranes	5.8%	6.4%

Table 4: Prevalences - Milking system

	Robot	No robot
Abomasal displacement	1.8%	1.8%
Hypocalcaemia (Milk fever)	6.3%	4.6%
Ketosis	10.4%	9.4%
Clinical mastitis	4.0%	3.5%
Metritis	4.4%	3.8%
Retained placental membranes	6.4%	6.1%

In Table 4, the average prevalences of farms with a milking robot and farms with conventional milking are given. Among the Flemish respondents all prevalences were higher on the farms with a robot. Of the Dutch prevalences, only those of hypocalcaemia, ketosis and clinical mastitis were higher on farms with milking robots. The prevalence of abomasal displacement was lower, and the metritis and retained placental membranes prevalence was similar in both groups.

On the farms feeding two different dry off rations, the prevalence of all diseases was lower among the Flemish farms, compared with farms feeding the same basic ration. Among the Dutch prevalences, this was only the case with abomasal displacement, hypocalcaemia and retained placental membranes. For ketosis and clinical mastitis, the prevalence was higher, and for metritis it was similar (Table 5).

Table 5: Prevalences - Different dry off rations

	No	Yes
Abomasal displacement	2.1%	0.8%
Hypocalcaemia (Milk fever)	5.8%	2.8%
Ketosis	10.7%	5.6%
Clinical mastitis	3.9%	2.7%
Metritis	4.5%	2.3%
Retained placental membranes	6.8%	3.6%

LOV – Follow up

The farmers who treated preventively with glucose (all animals or risk animals) were evenly distributed over the best and worst scoring 50% of the farms with an LOV. When the farmers who treated all animals (n=4) were not included, there was a slight difference visible between the farmers only treating risk animals and the farmers who never preventively treated with glucose, as 60% of the former were among the best 50% (Figure 34) against 50% of the latter. Although this difference was not very convincing, a remarkable feature was that 80% of the 5 best scoring five farms were treating the risk animals versus 20% that never did. There was not a significant difference between the farmers who treated risk animals and who never did (P = 0.76).

There might be an association between transitional problems at farms and to what extent the farmers keep an eye on the fresh cows. Only two farms had a Follow up score between 0 and 10 and were both farms among the upper 50% scoring farms. Comparing the farms scoring between 11 and 16 points with the farms with a score between 17 and 24 points, a larger

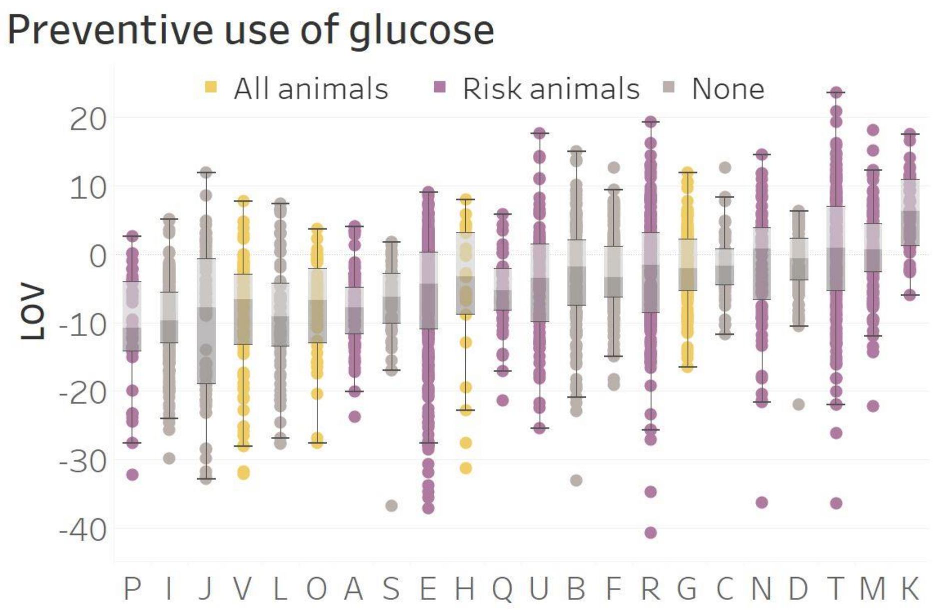

Figure 34: The farms with their calculated LOV's. The colour distribution shows if the farmer preventively treated all animals (yellow), risk animals (purple,), or no animals (grey) with glucose.

proportion of the former is among the best scoring farms (54.8% vs 28.6%). The difference in LOV's between both groups however was not significant (P = 0.9625).

There seemed to be a negative association between measuring ketone bodies and the LOV score, as 75% of the farmers (6/8) who measured ketone bodies were among the 50% lowest scoring farms (Figure 35). An explanation could be those were farms where measuring ketone bodies started because of a high prevalence of ketosis, as 5 out of 8 farmers who measured ketone bodies had a ketosis prevalence higher than 5%. The difference in LOV's however was not significant (P = 0.468).

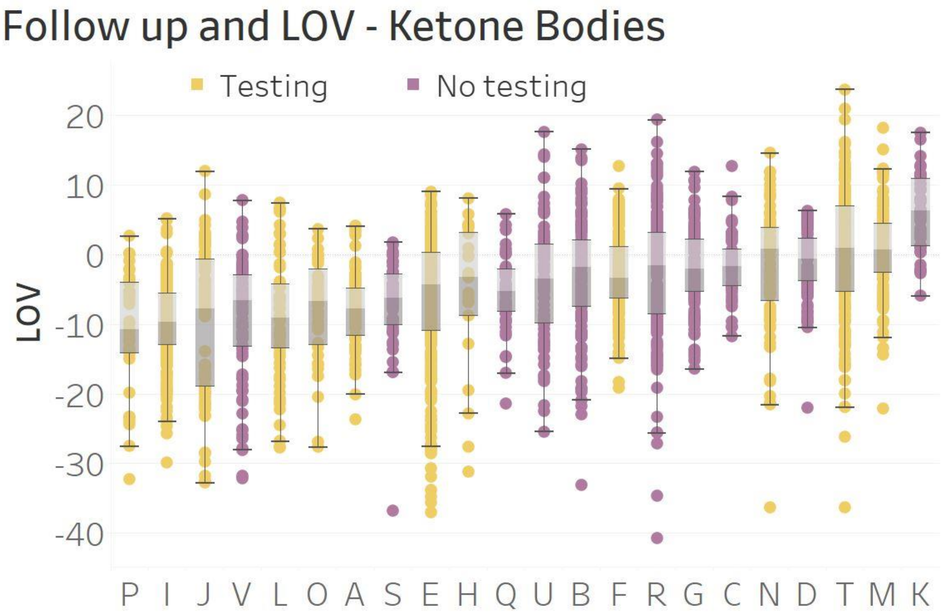

Figure 35: The farms with their calculated LOV's. The colour distribution shows if the farmer tested ketone bodies (yellow) or did not *(purple) as a follow-up method on fresh cows.*

Another negative association seemed to be between the daily monitoring of cow sensors, like sensors measuring rumination activity. 66.7% of the farmers who monitored daily were among the lower 50% scoring farms, while 70% of the farms without such sensors were among the 50% best scoring. The difference in LOV's between the two groups was not significant (0.14).

The only transition disease that had a remarkable colouring pattern was clinical metritis. Despite 9 farms had a prevalence higher than 4%, 66.7% of these farms were among the 50% with the highest LOV, and 61.5% (n=13) of the farms with a low prevalence (<4%) were represented in the 50% with the lowest LOV (Figure 36).

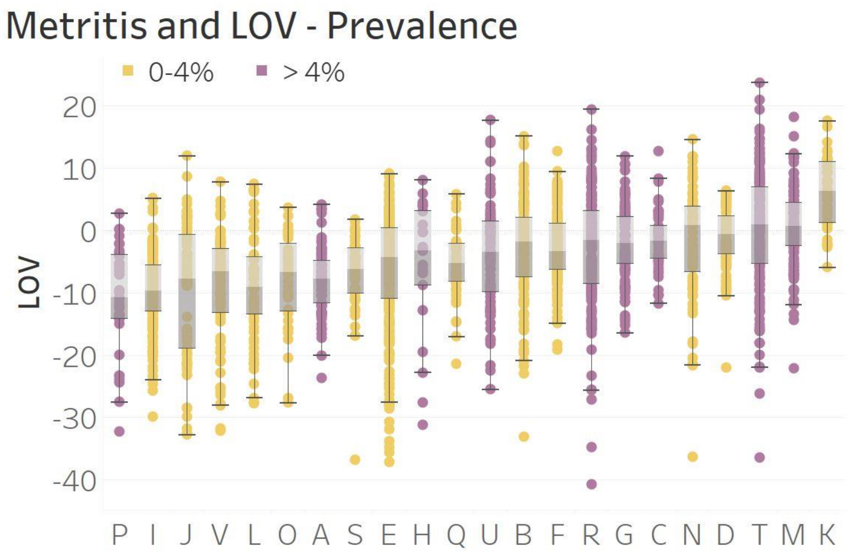

Figure 36: The farms with their calculated LOV's. The colour distribution shows if the farm had a reported prevalence of clinical mastitis shortly after calving beneath 3% (yellow), between 4 and 7% (blue) or between 8 and 14% (purple).

Discussion

The objectives of this study were to evaluate the transition management factors on different farms in the Netherlands and Belgium, and to extract potential risk/success factors from these data in combination with the LOV. A few aspects in the study design are important to consider in the interpretation of the results.

Results

The Flemish farms had smaller herds than the Dutch farms, as most consisted of 50-100 cows versus 100-200. Although there was not a difference found between the LOV's of the two countries, a positive association was found between herd size and the LOV with a tendency to be significant (P = 0.08). The bigger herds might have needed more adjustment to keep the farms manageable and might therefore contribute positively to the transition success.
Farms with a milking robot seemed to have a higher prevalence in some of the transitional diseases, but this was not visible in LOV's of the different groups. A possible explanation could be management factors being of greater influence on a successful transition than disease.

Too little data was present to interpret if the claw management on the farms was enough for a successful transition. Besides the trimming moment and frequency (Thomsen et al., 2019), other aspects of claw management also play a role in claw health, like the person performing the trimming, claw scores, the identification and incidence of claw disorders and the type of surface the cows are housed on (Holzhauer & Van Egmond, 2021). These aspects should be included in follow-up research.

Because each pen move has an impact on hierarchy (Cook & Nordlund, 2004), it might be better to keep a group of dried off cows intact instead of commingling cows, like all participating farmers did. The farms were probably too small to house separated dry off groups instead of adding cows to an existing dry off group after drying off. This aspect could therefore not be analysed.
Although there was a difference in dry off period between the two nationalities, it did not appear to influence the LOV. This might have been, because the differences in length were not big enough to be of influence. All periods were between 35 and 60 days. No short periods of 0-30 days (Kok et al., 2021), which might have shown a difference, were common on the participating farms. Another explanation might be that the recorded dry period by the farmer was not correct.
The same situation applied to the difference in dry off method. There was a difference in the use of AB between the countries and the use of BTD between several farms, but this was not resulting in a difference in LOV between the concerning farms. There might be a difference in the combinations of the methods (AB with or without barrier teat dips and with or without teat sealers), but more extensive statistical models would be needed to analyse this.
As a higher milk yield at dry off, causes a slower rate of teat closure, which is a risk factor for the onset of mastitis (Bradley & Green, 2004), one might have expected the maximum daily milk production would have an association with transition success. This was not the case, probably due to the high rate of AB used at those farms. Nevertheless, there might be an association with the amount of measures taken to reduce milk (all cows vs some cows). In further research, more farmers taking measures for some cows should be compared, with zooming in on which measures specifically.

The most striking result in the housing theme was the difference between the two nationalities in choice to which group the gestating heifers would be added before calving. There are records of the difference in heifer displacements between heifers who were introduced to the lactating herd pre calving versus post calving (De Vries et al., 2015), but not between introducing them to lactating cows or dry cows. The Dutch mainly chose for the dry cow group (58.8%) and the Flemish farmers mainly chose the lactating group (47.4%). The group who chose the lactating group were associated with a better LOV, which tended to be significant (P = 0.05). Introducing the heifers to the lactating group might be a success factor for transition. Another explanation could be that the heifers on those farms have a less optimal first lactation compared with the farms that housed them between the dry cows. This might have caused a less favourable starting situation for the heifers between the lactating group, which may result in bias on the LOV level. More research should be done to evaluate if this could be a true success factor for transition.

To continue on the subject of housing, there appeared to be two definitions of different dry off groups (FO and CU). The first definition, in which the groups were based om separated housing, applied to almost 50% of the farms. Only 19.4% of the farms were part of the group who had two dry off groups based on two different rations. Both aspects did not seem to be associated with the level of transition success.
25 % of the farms had a separated fresh cow group. This also seemed to have little influence on the LOV, which might be due to the variance between the lengths of keeping the fresh cows

apart. Pen moves were found to have the most behavioural effect in the first 48 hours, but effects on milk production or composition of 3-7 days or even longer also have been described (Cook & Nordlund, 2004). The 55.6% of the farms that kept the cows separately for 1-2.5 day may not have experienced a positive effect and therefore influence the outcome.

Calving management appeared to be the most relevant theme in this study. To begin with, there was a notable difference between the relative amount of calvings on Dutch farms versus Flemish farms. Most Flemish farms had more than one calve per cow each year, as 60% had over 100% calvings out of the total number of cows. This was only 30% in case of the Dutch farms. More calvings per year means more moments of risk per year, which might have been problematic for the average transitional success, but the opposite seemed to be true: farms with > 100 calvings a year had a significant better transition than the farms with 1-100 calvings ($P = 0.022$). An explanation might be that the cows on the farms had a better BCS due to a shorter calving interval.

Although sick animals could have a high infection load and transitional cows endure a level of immunosuppression (Pascottini et al., 2020), still 50% of the farmers used their calving pen as a pen for their sick cows. In this study however, this did not seem to affect the LOV as much as other factors.

The farms feeding two rations during dry off were was negatively associated with the LOV ($p < 0.01$), but this group consisted of only 4 farms. More farms should be compared to confirm or deny this association.
In the nutritional theme, not a lot of associations emerged, which might imply the different factors did not have much influence on the LOV as much as other factors. Other explanations could be the different rations affecting the LOV in the same degree, the questions being not specific enough, or other aspects playing a role, like quantity, the precise composition of specific ingredients and the continuity of the nutrition. Going into detail like that would exceed the objectives of this study and would be more appropriate in a specific nutritional study.
Nevertheless, there were some notable results from the survey itself. Close-up cows were fed a more energy-dense ration than far-off cows. Almost all farmers were feeding dry cow minerals (97.2%), but few fed anionic salts (6.9%) and no one fed calcium binders. An association with transitional success could not be made. As a lot of farmers fed 'transitional concentrates' of their food supplier, anionic salts and calcium binders could have been in the feed already. Most farmers did not know however, so if they fed them it was not a deliberate choice.

In the last theme, the follow-up, the most striking result was that Flemish farmers were doing more follow-up measurements to cows after calving and were performing more preventive treatments before calving compared with the Dutch. Despite this, it was not translated in better LOV's. As the reported prevalences were higher on the Flemish farms, this might have been an explanation for the lack of better LOV's on these farms. However, the farms with high disease prevalences were not negatively associated with the LOV. As mentioned before, the prevalences were reported prevalences, so the differences between the two countries might not have been as big as outlined in the results.

Possible limitations

In the first place, when processing data from a survey one faces the interviewer effect and the respondent effect. Although the interviewer had standardized the way of conducting the survey as good as possible and checked if the questions were clear, this might have created some bias. Besides that, the interviewer for the Dutch farms was a different person than the one for the Flemish farmers. To avoid differences in interpretation of the interviewers, the survey was thoroughly reviewed by both interviewers with the same supervisor. The positive side of having the interviewer present when filling in the questionnaire, the interviewer could make sure bias by any differences in interpretation among the farmers was diminished. Bias by possible lack of objectivity of the farmers was also reduced by limiting the answer options, but the subjectivity needs to be reminded interpreting the results.

Another limitation was in the total number of farms that could get calculated LOV's, which was not possible on 14 farms because of technical difficulties. Although 22 farms contain a lot of data of individual cows, some management strategies could not be compared because of too few farms with those strategies were among the farms with an LOV. A final aspect which might have contributed to this was the location of the Dutch farms. All 17 farms were located in the centre of the Netherlands and were with the same veterinary practice. On top of that, the farmers joined the research voluntary, which selects farmers who care and who might be having transitional problems.

Therefore, these data might not represent the population of the whole Netherlands.

The LOV's of the 22 farms were analysed over the period from the first of January, 2020 until the first of March 2021. This was the most recent period with correct data from all farms. Some management strategies could be more variable (like a feeding method) than others and might not be applicable for that period.

This study looked into the mean LOV's. Some farms had a wide range of individual cow LOV's compared with other farms. This might be an interesting aspect for further statistical analysis of the results and may imply the KPI is not effective and needs to be validated or corrected.

Conclusion

This study has provided insight in the management strategies for transition of dairy cows on 36 Dutch and Flemish farms. Clear associations and less clear associations were found between management aspects and the success of transition, based on the LOV.

Factors which were associated with a better LOV were the occurrence of more than 100 calvings per year (vs < 100 calvings) and the introduction of heifers into the lactating group versus the dry cow group. Factors that might be associated with a better LOV, but which were less clear due to a small group, were feeding one ration during dry off versus two rations and taking milk reducing measures to all cows before drying off, instead of some cows.

Now that a broad insight of the results and their influence on transition has been gained, more extensive statistical models should be set up and follow-up research should be carried out that zooms in on these aspects.

References

Bradley, A. J., & Green, M. J. (2004). The importance of the nonlactating period in the epidemiology of intramammary infection and strategies for prevention. *Veterinary Clinics of North America: Food Animal Practice*, *20*(3), 547–568. https://doi.org/10.1016/j.cvfa.2004.06.010

Calderon, D., & Cook, N. (2011). The effect of lameness on the resting behavior and metabolic status of dairy cattle during the transition period in a freestall-housed dairy herd. *Journal of Dairy Science*, *94*(6), 2883–2894. https://doi.org/10.3168/jds.2010-3855

Cook, N. B., & Nordlund, K. V. (2004). Managing the transition cow to optimize health and productivity. Veterinary Clinics of North America: Food Animal Practice, 20(3), xi–xii. https://doi.org/10.1016/j.cvfa.2004.06.007

Cook, N. B., & Nordlund, K. V. (2004). Behavioral needs of the transition cow and considerations for special needs facility design. *Veterinary Clinics of North America: Food Animal Practice*, *20*(3), 495–520. https://doi.org/10.1016/j.cvfa.2004.06.011

Crowe, M. A., Hostens, M., & Opsomer, G. (2018). Reproductive management in dairy cows - the future. Irish Veterinary Journal, 71(1). https://doi.org/10.1186/s13620-017-0112-y

de Vries, M., Bokkers, E.A.M., van Reenen, C.G., Engel, B., van Schaik, G., Dijkstra, T., de Boer, I.J.M.,Housing and management factors associated with indicators of dairy cattle welfare, Preventive Veterinary Medicine (2014), http://dx.doi.org/10.1016/j.prevetmed.2014.11.016

Drackley, J. K. (1999). Biology of Dairy Cows During the Transition Period: the Final Frontier? Journal of Dairy Science, 82(11), 2259–2273. https://doi.org/10.3168/jds.s0022-0302(99)75474-3

Goossens, T. (2021). Evaluation of the transition management in high producing dairy herds (Master Thesis Gent University).

Grummer, R. R. (1995). Impact of changes in organic nutrient metabolism on feeding the transition dairy cow. Journal of Animal Science, 73(9), 2820.
https://doi.org/10.2527/1995.7392820x

Holzhauer, M., & Van Egmond, R. J. (2021). A proposed structural approach to improve cow-claw health on Dutch dairy farms. *Journal of Dairy Research*, *88*(4), 388–395. https://doi.org/10.1017/s0022029921000753

Kok, A., Chen, J., Kemp, B., & Van Knegsel, A. (2019). Review: Dry period length in dairy cows and consequences for metabolism and welfare and customised management strategies. Animal, 13, s42–s51. https://doi.org/10.1017/s1751731119001174

Kok, A., Van Hoeij, R., Kemp, B., & Van Knegsel, A. (2021). Evaluation of customized dry-period strategies in dairy cows. Journal of Dairy Science, 104(2), 1887–1899. https://doi.org/10.3168/jds.2020-18719

LeBlanc S. (2010). Monitoring Metabolic Health of Dairy Cattle in the Transition Period. Journal of Reproduction and Development, 56(S), S29–S35. https://doi.org/10.1262/jrd.1056s29

Liseune, A., Salamone, M., Van den Poel, D., Van Ranst, B., & Hostens, M. (2020). Leveraging latent representations for milk yield prediction and interpolation using deep learning. COMPUTERS AND ELECTRONICS IN AGRICULTURE, 175. https://doi.org/10.1016/j.compag.2020.105600

Liseune, A., Salamone, M., Van den Poel, D., Van Ranst, B., & Hostens, M. (2021). Predicting the milk yield curve of dairy cows in the subsequent lactation period using deep learning. COMPUTERS AND ELECTRONICS IN AGRICULTURE, 180. https://doi.org/10.1016/j.compag.2020.105904

Mulligan, F., O'Grady, L., Rice, D., & Doherty, M. (2006). A herd health approach to dairy cow nutrition and production diseases of the transition cow. Animal Reproduction Science, 96(3–4), 331–353. https://doi.org/10.1016/j.anireprosci.2006.08.011

Mulligan, F., & Doherty, M. (2008). Production diseases of the transition cow. The Veterinary Journal, 176(1), 3–9. https://doi.org/10.1016/j.tvjl.2007.12.018

Overton, T., McArt, J., & Nydam, D. (2017). A 100-Year Review: Metabolic health indicators and management of dairy cattle. Journal of Dairy Science, 100(12), 10398–10417. https://doi.org/10.3168/jds.2017-13054'

Overzicht gesteunde LA-trajecten | Agentschap Innoveren en Ondernemen. (2018, 20 april). Agentschap Innoveren & Ondernemen. Geraadpleegd op 3 september 2021, van https://www.vlaio.be/nl/nieuws/overzicht-gesteunde-la-trajecten

Pascottini, O. B., Leroy, J. L. M. R., & Opsomer, G. (2020). Metabolic Stress in the Transition Period of Dairy Cows: Focusing on the Prepartum Period. *Animals*, *10*(8), 1419. https://doi.org/10.3390/ani10081419

Roche, J. R., Burke, C. R., Crookenden, M. A., Heiser, A., Loor, J. L., Meier, S., Mitchell, M. D., Phyn, C. V. C., & Turner, S. A. (2018). Fertility and the transition dairy cow. Reproduction, Fertility and Development, 30(1), 85. https://doi.org/10.1071/rd17412

Rotz, C. A. (2017). Assessing carbon footprints of dairy production systems. In G. Thoma (Red.), Large Dairy Herd Management (3de ed., pp. 19–23). FASS Inc. https://doi.org/10.3168/ldhm.0100

Soonberg, M., Kass, M., Kaart, T., Barraclough, R., Haskell, M. J., & Arney, D. R. (2021). Effect of grouping on behaviour of dairy heifers and cows in the transition period. *Journal of Dairy Research*, 88(1), 45–51. https://doi.org/10.1017/s0022029921000066

Thomsen, P. T., Foldager, L., Raundal, P., & Capion, N. (2019). Lower odds of sole ulcers in the following lactation in dairy cows that received hoof trimming around drying off. *The Veterinary Journal*, *254*, 105408. https://doi.org/10.1016/j.tvjl.2019.105408

Zebeli, Q., Ghareeb, K., Humer, E., Metzler-Zebeli, B., & Besenfelder, U. (2015). Nutrition, rumen health and inflammation in the transition period and their role on overall health and fertility in dairy cows. Research in Veterinary Science, 103, 126–136. https://doi.org/10.1016/j.rvsc.2015.09.020