Artykuł przeglądowy *Review*

Reasons for culling, culling due to lameness, and economic losses in dairy cows

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Summary

The review presents reasons for the culling of dairy cows, focusing on clinical lameness and production losses in cows affected by lameness. The culling of cows is a technique that may lead to herd improvement and increased profits or reduced costs by replacing sick or non-pregnant cows. The reasons for culling are generally voluntary, for example poor production, or involuntary, including mastitis, extreme lameness or poor reproduction, and/or death. Culling rates in dairy herds vary, ranging from 20% to 35% per year. The most common reasons for culling dairy cows in herds are diseases, such as mastitis, reproductive diseases, and clinical lameness. Many other factors, such as parity, lactation stage, reproductive performance, health, calving season, milk yield and cow welfare, also influence the decision to cull a cow. Effects of lameness reduce milk yield, negatively affect fertility, and increase the risk of culling. Milk loss contributes 40% to the cost of lameness, followed by treatment costs (34%) and decreased fertility (26%). Many studies report an increased risk of culling for lame cows with hoof diseases, especially sole ulcers. Some studies, however, indicate that the effect of lameness on culling is unclear because the literature provides little information on the reasons for culling and, in particular, on the relation between reproductive performance and the incidence of mastitis or lameness. Hence, the decision to cull a cow is complicated and often depends on the parity, milk production, fertility, and health of cows.

Keywords: cow, culling, lameness, economic loss, productivity

The culling of cows is a technique that may lead to herd improvement and increase profits or reduce costs by replacing sick or non-pregnant cows (21). Culling is the departure of cows from the herd as a result of sale, slaughter, salvage, or death. Culling is referred to as either voluntary or involuntary. Voluntary culls are cows culled because they are poor producers, whereas involuntary culls are those culled out of necessity, due to mastitis, extreme lameness, poor reproduction or death (11). Esslemont and Kossaibati (8) in their study concerning 50 herds in Britain, conducted in the years from 1990 to 1992, reported that voluntary culling constituted 11.3% of disposals, and 88.7% was involuntary or necesssary (8). In another study by Rajala-Schultz and Gröhn (21) culling proportions in dairy herds ranged from 20% to 35%. These results are in agreement with those reported by Bell et al. (1), according to whom culling rates for cows were approximately 25% per year and 59% before the fourth parity. Culled cows were older and had a low number of milking days and a greater number of days from calving to conception (1, 5, 18, 27). One should add that a considerable proportion of culled cows were pregnant. The incidence of pregnancy in cows slaughtered during different periods was 23.5% (26). A total of 2,502 uteri were examined, 587 of which were pregnant. Out of the 587 pregnancies, 141 (24.0%) were in the first trimester of pregnancy, 288 (49.1%) in the second, and 158 (26.9%) in the third. The most common reason for culling was infertility (28.2%), followed by mastitis (21.8%) and old age (15.8%). These results demonstrate that errors in culling decisions are common, and farmers should improve their recording systems and have cows accurately tested for pregnancy, especially before culling.

The objective of this study was to describe the reasons for culling in dairy cows (especially the reasons associated with clinical lameness) and to discuss the cost of lameness on the basis of the literature.

Risk factors and reasons for culling

The effect of diseases on culling. Rajala-Schultz et al. (21) report that diseases have a significant effect on the culling of dairy cows. The effect of diseases is varied and depends on the time of their occurrence and the stage of lactation. Mastitis, teat injuries and lameness have a significant effect on culling throughout

lactation. These diseases constitute the highest risk of culling. The authors believe that diseases affected culling mostly at the time of their occurrence. Many diseases (milk fever, dyscotia and metritis) had a significant impact on culling at the end of lactation. The age of cows also had an effect on culling decisions. Mastitis was the most common infectious disease that contributed to culling and was responsible for an average of 10.1% of disposals. Culling due to mastitis increased linearly with parity and accounted for nearly 14% of cows culled in the sixth lactation (8). The culling of cows with mastitis is likely to reduce the risk of future infections in the herd. The mastitis status is an important consideration in the decision to keep or replace cows (28). Among non-infectious diseases, bovine spongiform encephalopathy (BSE) was responsible for 7.4% of disposals over three seasons. Lameness accounted for 5.6% of disposals and increased with age from 3.5% in the first lactation to 9% in the seventh lactation. The combined culling rate for lameness and leg injuries was 9.9%. Generally, poor fertility, mastitis, BSE and lameness were the major reasons for culling in the 50 herds investigated (of an average size of 178 cows). According to Gröhn et al. (13), the proportion of cows developing a disease during lactation (lactational incidence risk; %) was varied, but highest for lameness and mastitis, for which it was calculated at 32.0% and 21.1%, respectively. Other diseases occurring during lactation accounted for 1.2% (dystocia) to 9.2% (cystic ovaries). The reported incidence of clinical lameness ranged from 21% per lactation (8) up to 70% (14). According to Heuer at al. (15), endometritis occurred during more than 20 days postpartum. Mastitis, cystic ovarian disease, and lameness were recorded throughtout lactation, but half of all mastitis cases occurred within 9 weeks after calving. Reproductive diseases play an important role in culling decisions (22, 23). The knowledge about the pregnancy status of cows had different effects on culling decisions, depending on the stage of lactation. The earlier the farmer knew that a cow was pregnant, the lower was the risk of culling. Mastitis, teat injuries, lameness, ovarian cysts, anestrus and milk fever were the most important diseases affecting culling. Risk factors for culling were also associated with conception failure and with the fact that cows had had an assisted calving, had aborted and/or suffered from mastitis (1). The most frequent reasons for culling were infertility, low milk yield and udder-related disorders, which accounted for 26.1%, 16.6% and 12.3% of total culls, respectively (25). More than half of the culls were related to health or reproductive disorders. Out of a total of 5,133 culled cows, those culled for udder disorders left the herd earlier in lactation and were more frequently at parities 4-6 than cows culled for voluntary reasons. In contrast, cows culled for infertility were younger and culled later in lactation. Cows culled for lameness were similar to those from the voluntarily culling group (2.2%). Farms with the highest quartile of disposals culled on average 35% of their cows in 12 months: 12% for infertility, 9% for mastitis and 5% for lameness. The lowest quartile culled 12% of cows, including 1.0% for infertility, 0.2% for mastitis and none for lameness (29).

Parity and calving season. The decision to cull a cow is influenced by many factors, such as parity, lactation stage, reproductive performance, health, calving season, milk yield, and the welfare of cows (23, 25, 27). The risk of culling increased with increasing parity (23). When adjusted for milk yield, but not for pregnancy status, cows in the 6th parity or higher were at a 4.4 times higher risk of being culled than those in parity 1. When adjusted for both milk yield and pregnancy status, the risk of being culled was lower: cows in the 6th parity or higher were 3.4 times more likely to be culled than cows in the 1st parity. Calving season was also an important factor in culling decisions in both models analyzed. When milk yield was included in the model, only cows calving in winter were at a significantly higher risk of being culled than those calving in fall and than the highest producing cows.

Milk yield and pregnancy status. Milk yield and the stage of lactation have a significant impact on culling (23). The level of milk production during the first 30 days after calving did not have any effect on culling; only cows with missing information on previous lactations were at a higher risk of being culled. Heifers were 1.6 times more likely to be culled during the first month of lactation than older cows. Such factors as pregnancy status, milk production and diseases play an important role in culling decisions; however, their effects vary depending on the stage of lactation. Pregnant cows were less likely to be culled, but low producers were more likely to be culled than high producers. The production of milk does not have a significant influence on culling at the very beginning of lactation, only later during the lactation. Older cows are at a higher risk of culling than younger cows.

Time of culling. Earlier culling was related to lameness in the first lactation (27). Reasons for culling were hemorrhages of the sole (score 2-3). In the second and further lactations the main reasons for culling were heel-horn erosions and sole ulcers. Sole ulcers diagnosed in the first 4 months of lactation were found to reduce survival (3). Similarly, Collik at al. (5) report that sole ulcers or white line diseases are significantly associated with the risk of culling for lame cows. Sole ulcers tended to have a significant effect on culling during mid-lactation, but little effect if diagnosed during early and late lactation (3). Culled cows were characterized by a lower carcass weight, conformation class, fat cover class and economic value of the carcass (27).

Culling due to lameness

The effect of lameness on the loss of production. Diseases reduce the efficiency of production mainly in three ways: by decreasing milk production, by reducing reproductive performance, and by shortening the

life-expectancy of dairy cows and thereby increasing the culling risk (14). Lameness was observed to decrease milk yield (12) and fertility (1, 5, 18), and to increase the risk of culling (5, 17, 27). The cost of lameness consisted of milk production losses, the effect of decreased fertility, and treatment costs, which represented, respectively, 40%, 26%, 34% of the total cost (13). In a study by Cha et al. (4) the cost of different types of lameness was calculated at the individual cow level. The authors categorized lameness into non-infectious lameness, infectious lameness, and foot rot (interdigital phlegmon). For the non-infectious and infectious categories one condition representative of each category was selected. Sole ulcers were chosen to represent the non-infectious category, and digital dermatitis, the infectious category. The average cost per case (US $; $ 1 = approx. € 0.74 in January 2011) of soles ulcers, digital dermatitis, and foot rot was $ 216.07, $ 132.96 and $ 120.70, respectively. The most important contributions to the total cost per case of sole ulcers were milk production losses ($ 82.97; 38%), followed by the impact of decreased fertility (71.84 $; 33%) and treatment cost ($ 61.25; 28%). In contrast, the treatment cost per case of digital dermatitis was higher (42%) than the effect of decreased fertility (31%) and milk loss (27%). In the case of foot rot the effect of decreased fertility accounted for over 50% of the total cost, followed by milk loss (28%) and treatment cost (27%). It is necessary to stress that the average cost of lameness was greater in younger cows. Lameness was found to be associated with reduced fertility. The results presented by Collik et al. (5) indicated a larger increase in the interval from calving to conception in lame cows (14 days) than that for the interval from calving to the first service (4 days), suggesting that the main effect of lameness may be connected with conception or the maintenance of pregnancy. In lame cows, decreased milk yields occurred from the 4th month before until the 5th month after a cow was diagnosed as clinically lame and caused up to 360 kg milk loss over a lactation (12). According to these authors, this information is important for assessing the economic impact of lameness as well as its impact on cow health.

Impact of lameness on culling. An increased risk of culling in lame cows with hoof diseases was found in several studies (3-5, 21). Sole ulcers in dairy cattle are strongly associated with a reduced reproductive performance and a high milk production in the same lactation (16, 19, 20). According to some authors, the effect of lameness on culling is not clear, because several authors report little or no increase in culling due to lameness (4, 6, 10). Cows diagnosed with lameness during the first 60 days in milk (DIM) seemed most likely to be culled between the 121st and 240th DIM (3). Cows diagnosed with lameness between the 61st and 120th DIM were at the greatest risk of being culled in that period; however, this was the case only in some models. Similarly, only in two models significantly higher risks of culling were shown for lame cows in which lameness was diagnosed after the 120th DIM. Those results indicate that the effect of lameness on culling seems to depend on the time when lameness is diagnosed and the time of culling. Lameness occurring late in lactation (> 240 DIM) had a smaller association with culling. Earlier culling of lame cows is in agreement with other studies (16, 21). Cramer et al. (6) report that among 6,513 cows, of which 1,293 (19.9%) were culled, the non-culled cows had infectious foot lesions (digital dermatitis, heel horn erosion, and foot rot), whereas hoof horn lesions (white line diseases, ulcers, and hemorrhage) were most prevalent among the culled cows. Thus, hoof horn lesions were associated with an increased culling risk. In order to reduce the effect of hoof horn lesions on cow longevity, it seems necessary to detect them earlier. The risk of culling for pregnant cows fell sharply; however, the later in lactation a cow became pregnant, the greater was her risk of being culled (24). The effect of veterinary-treated clinical mastitis is important throughout lactation; however, for open cows the effect of veterinary-treated mastitis is more marked in early lactation.

The economics of culling lame cows

From an economic point of view, clinical lameness is considered to be one of the major health disorders in dairy cattle (9). The costs of treating a lame cow differ across countries, across farms, across underlying diseases causing lameness, and across people responsible for treating the cow (8, 11, 18). The direct cost associated with those diseases is defined as the value of the loss in expected output or resource wastage due to the disease, together with the costs of treatment and prevention incurred in mitigating the effect of the disease on production (2). Kossaibati and Esslemont (17) calculated the costs of lameness, distinguishing three types of lameness: digital dermatitis, interdigital dermatitis, and sole ulcers. The direct cost per case in lame cows with digital dermatitis was £ 93; however, when reduced fertility was taken into account, the total cost per affected cow increased to £ 240. The direct cost per case in lame cows with interdigital dermatitis was £ 58, and the total cost per lame cow was £ 131. The costs per case of interdigital lameness are lower than those in digital lameness because the former has no effect on the culling rate. Sole ulcers are the most severe type of lameness, and the most expensive condition. The direct cost per affected cow was calculated at £ 119 and the average total cost at £ 425 (£ 1 = approx. € 1.19 in January 2011). Bennet et al. (2) estimated direct costs for five diseases affecting dairy cattle in the United Kingdom: bovine viral diarrhoea (BVD), fasciolosis, lameness, leptospirosis and mastitis (including summer mastitis). The costs for these five endemic diseases were estimated for low and high output losses. The differences between low and high estimates of output losses in milk production, which were associated with mastitis and with

lameness were considerable, as they amounted to 46.2 and 149.6% of output in case of mastitis, respectively, and 19.0 and 52.3 of output associated with lameness. Both diseases significantly influence losses in milk production. Enting et al. (7), in their study of data on 2,183 cows (mainly Holsteins and Dutch Friesians) and 6,273 lactations, observed one or more cases of clinical digital diseases in 21.2% of lactations in the dataset. Economic losses resulting from clinical digital diseases were found to be almost NLG 50 per average cow in the herd per year (NLG 1 = approx. € 0.45 in January 2011). The losses per average foot-lame cow were about NLG 230. Lameness in cows is a major disease in Dutch dairy cattle, followed by mastitis (NLG 150 loss per average cow) and fertility problems (NLG 125 per average cow). In a Danish dairy herd the costs per case of clinical lameness per cow/year were reportedly € 192. The highest losses per case were estimated at € 278 in a herd with a low pregnancy level. The lowest losses per case of clinical lameness, amounting to € 178, were found in a herd with low milk yields (9). Newer data showed the use of hyper-distributions describing disease risk by an existing dynamic, stochastic and mechanistic simulation model of a dairy herd (10). Three diseases causing lameness were modelled: digital dermatitis, interdigital hyperplasia, and claw horn diseases. Next, the existing simulation model was set up in a way that uses hyper-distribution describing the disease risk of the three lameness-causing diseases. The use of such a model reduced the risk of lameness-causing diseases in the herd.

Recapitulation

Mastitis, impaired fertility, and reproductive diseases, as well as clinical lameness, are the most common reasons for culling in dairy cows. The decision to cull a cow is also influenced by many other factors, such as parity, lactation stage, reproductive performance, health, calving season, milk yield and the welfare of cows. The culling proportion in dairy herds ranges from 20% to 35% per year. All diseases affect culling decisions mostly at the time of their occurrence. However, mastitis and lameness may occur at any time during lactation. The effect of lameness on culling is still unclear, because the literature provides little information on the reasons for culling cows and, in particular, on the relation between reproductive performance and the incidence of mastitis or lameness. Hence, the decision to cull a cow is complicated and notably depends on the parity, milk production, fertility, and health of cows. Clinical lameness is considered one of the major health disorders in cows. The costs of treating a lame cow differ across countries, across farms, across diseases causing lameness, and across people responsible for treating the cow. Sole ulcers are the most severe type of lameness. As it was reported by Kossaibati and Esslemont (17) in their study on 90 Friesian-Holstein herds (average size 152 cows) the direct cost per case in lame cows amounted to £ 119, but the average total cost was £ 425. In view of such considerable economic losses caused by lameness this problem needs to be further investigated in order to provide farmers with reliable indications concerning recommendations for culling.

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