Longevity and culling rate: how to improve?

Jelle Zijlstra*, Ma Jiayang**, Cao Zhijun** and Bennie van der Fels*
** Wageningen Livestock Research, Wageningen*
*** China Agricultural University, Beijing*

1. The importance of longevity and culling rate

Animal health problems in dairy herds create extra costs, reduce milk production and will lead to high involuntary culling rates. In the Netherlands as well as in China dairy experts consider disease incidence rates and suboptimal culling rates as indicators of bottlenecks in dairy farm management. Improving health and animal welfare will result in longer living cows and this is why high longevity and lifetime production are seen as indicators for good dairy farm management. Improvement of this longevity is associated with lower culling rates.

Health problems are not only causing loss of profit but also disturb the workflow on the farm. Sick cows have to be treated and need extra attention until recovery. They will also cause infectious risks for the rest of the herd and should therefore be kept in isolation to avoid contamination.

The vision of farmers and consultants on longevity and culling is strongly influenced by views within the dairy industry and by the state of knowledge on animal health within the sector. These points are the reason that both topics evoke different associations in China and in the Netherlands. Table 1 lists some of these cultural differences.

Table 1. Differences about longevity aspects between China and the Netherlands

Aspect	**China**	**Netherlands**
Statistics	Start with pilot to collect data about culling rates and culling reasons	National statistics available about, longevity, lifetime production, culling rates and culling reasons
Available young stock	Shortage of young stock. Extra supply of heifers from New-Zealand and Australia	Farmers rear more young stock than needed for replacement. Part is exported outside EU.
Determining factors for longevity	Shortage of young stock and high milk prices stimulate farmers to keep suboptimal producing cows longer	High incidences of fertility, hoof and udder problems are constraining longevity
Longevity is indicator for farm management quality	Longevity became an important indicator for farm management quality in most large-scale dairy farms of dairy groups in recent years, while few individual farms take it as one of the important indexes.	Yes, this is the general opinion
Vision society	Animal welfare is becoming a public concern and more and more farm managers believe that cow welfare related with production efficiency.	Society desires good cow care resulting in more animal welfare and longer living cows
Financial incentives to increase longevity	In general: increasing longevity is not always expected to be profitable. It is more associated with lack of young stock.	In general: increasing longevity is considered to be profitable for the farmer Some dairy processors pay bonus on milk price to farmers with older cows

The Netherlands have a long tradition in aiming at high lifetime production of cows. For many decades cows that pass the limit of 100,000 kg milk or 10,000 kg fat and protein are honoured at a party on the farm. And of course the farmer who cared for the cow, is part of this tribute. In the last five years longevity receives extra attention from society because it is seen as an indicator of good care for cows. This is why the dairy sector is now aiming at increasing longevity by half a year during the period until 2020. This goal is part of the sustainability program of the united Dutch dairy companies and dairy farmer unions.

The goal of this paper is to present the results and experiences of collaborative work on longevity and culling rate on dairy farms. In 2015 Wageningen UR Livestock Research and China Agricultural University investigated the present situation on longevity and culling in both countries. Wageningen UR livestock

Research summarized the efforts done in the Netherlands to come to an improvement program on longevity. China Agricultural University collected data of 81 farms with 113,367 dairy cows aiming at getting a better insight into culling practices on Chinese dairy farms.

2. Present situation in the Netherlands

The average age at culling (also defined as longevity) of Dutch dairy cows is 5.8 years[1]. In the last five years this figure has been quite stable. As mentioned before the Dutch dairy sector has the ambitious goal to increase it by six months in the period until 2020. Research showed that there is much variation between farms for this trait. The 25% farms with highest longevity have an average longevity of 7.1 years, whilst the 25% farms with lowest longevity have an average longevity of 4.9 years. This variation shows quite some potential to improve longevity.

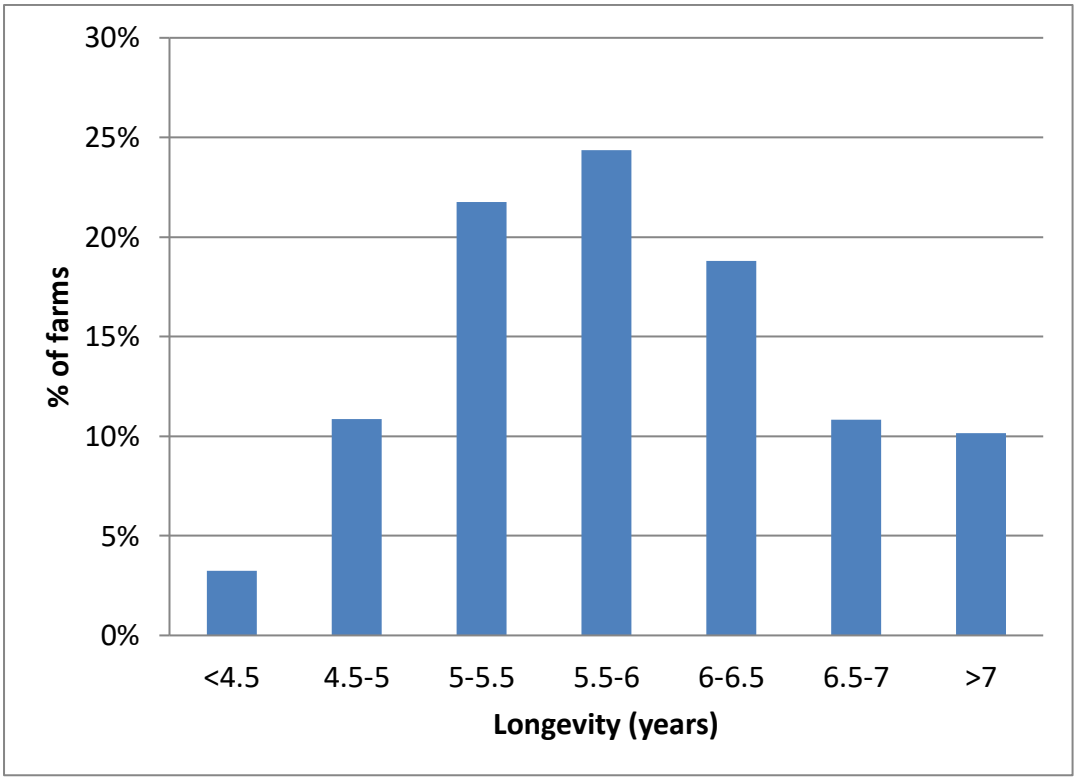

Figure 1. Distribution of Dutch farms across longevity classes[2]

Figure 2 shows the division of culls by parity for Dutch cows on farms where culling reasons were recorded. The proportion of herds that record culling reasons has steadily grown in the last decade. In 2012 it was increased until 32% of all farms participating. The pattern shown by the bars in figure 2 is strongly connected to longevity. If longevity increases, a larger part of the culls will take place in higher parity numbers.

Figure 3 shows the reasons for culling on Dutch farms. Fertility, cell count/mastitis and legs and claws are the most frequently mentioned reasons for culling. The fourth reason 'fattening' is a kind of indirect reason for culling. Farmers will usually only fatten cows if they have decided to cull the cow at a later stage but like to combine milk production with fattening in the remaining productive life of the cow. The underlying reason for this decision can be e.g. infertility or disease incidences. Fattening is a kind of voluntary culling with an involuntary underlying reason. The same can be more or less true for other voluntary culling reasons like excess cows, low production and old age. This combined voluntary and involuntary culling reasons show that the differences between these two main categories are not easy to mark. However, Figure 3 shows very clearly that that fertility, mastitis, claws and miscellaneous health problems are the main reasons for involuntary culling on Dutch farms.

[1],CRV, 2015
[2] Zijlstra et al., 2013 (data of Dutch farms during the period 2006 until 2012)

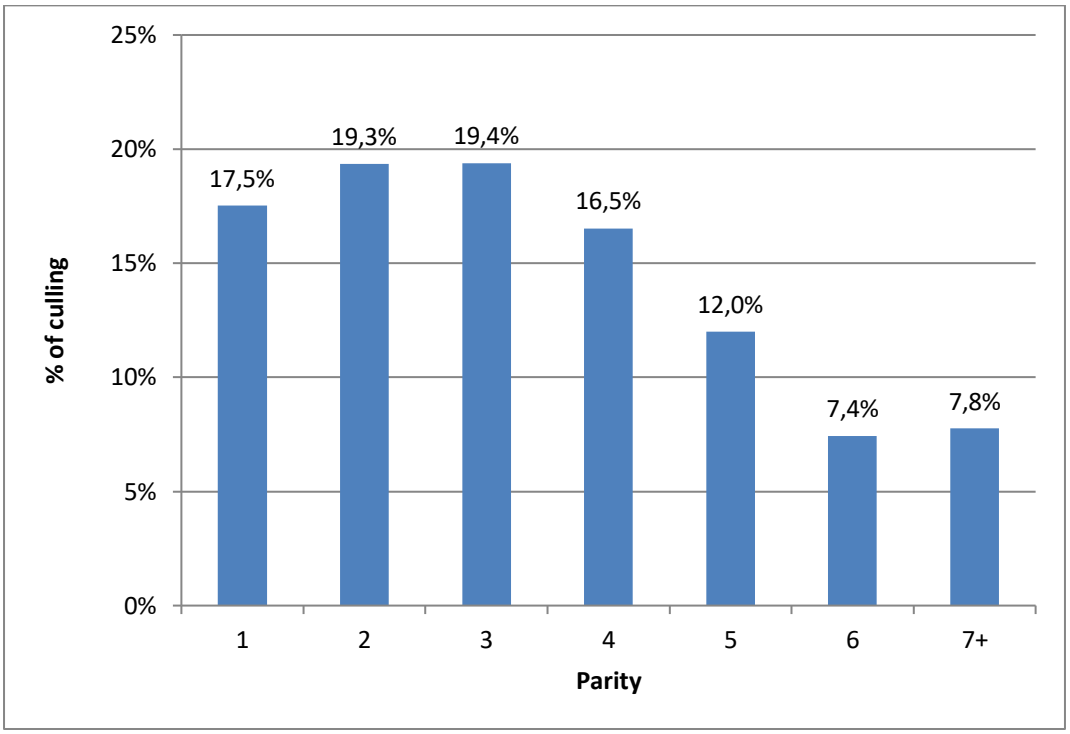

Figure 2. Percentage of culls by parity[3]

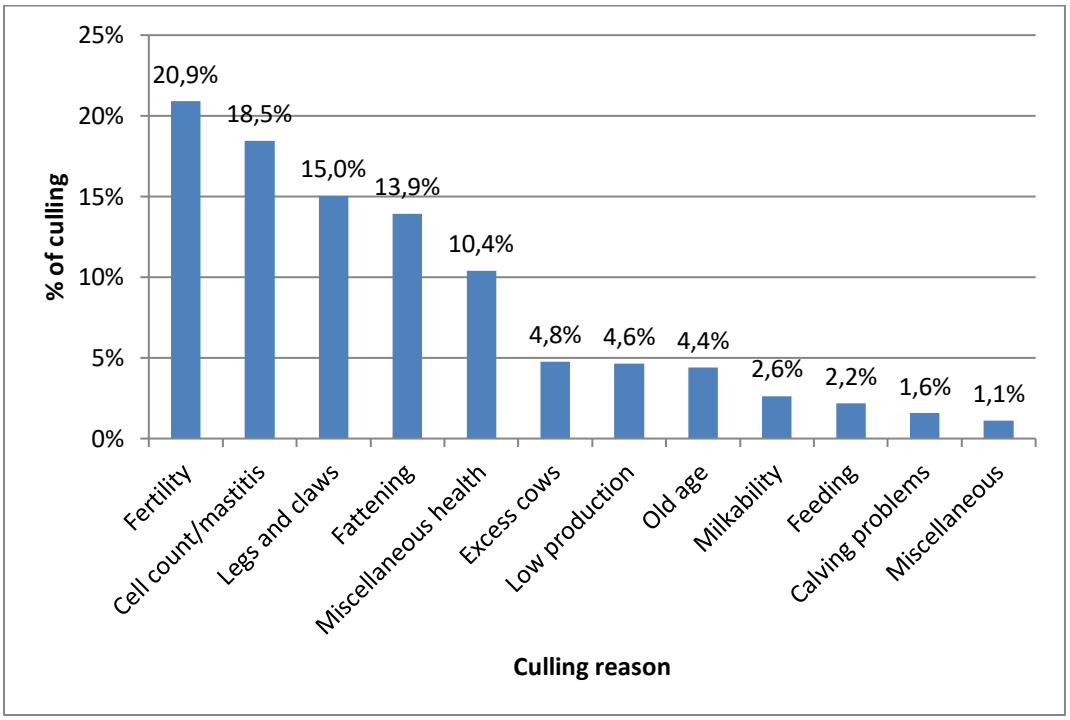

Figure 3. Reasons for culling[3]

[3] Based on CRV data from 284,864 cows with minimal 87.5% Holstein breed, that were culled in the years 2007 until 2012.

3. Present situation in China

As mentioned before China Agricultural University collected data from 81 farms with 113,253 dairy cows (including dry and lactating cows) in total. The average herd size of these farms was 1398 cows.

Actually, the study comprised two main parts:
1) Individual cull information (farm visits and questionnaire)
2) Group dairy farm data

Firstly, participating dairy farms noted the reasons for culling of every cow that left the herd over a twelve-month period, starting in 2013. Secondly, these culling records provided primary culling reasons for each cow leaving the herd, resulting in a list of 50 culling reasons. Thirdly, each participating herd was sent a questionnaire asking for specific and detailed information on the management system of their herd. The questionnaire asked for details about the herd management system including fertility management, herd replacements, housing, milking, labour, and nutritional aspects. Table 2 shows a summary of the general statistics of the participating farms.

Table 2. General statistics for the provisional data in 2014

Total number of cows	113,253
Number of herds	81
Average herd size	1,398
Total number of cullings	26,431
Culling rate (%/year)	23.3%

Table 3. Number of farms and cows by different herd size (2014)

Range of herd size	No. of farms	No. of cows	No. of culled cows
>2000	16	72,069	15,557
1000-2000	13	17,001	3,984
500-1000	19	13,191	3,697
100-500	33	10,993	3,193
Total	81	113,253	26,431

Among these farms, 31 farms have lower culling rate than 23.3%. 76 of the farms recorded the parity of 25,917 culled cows and 65 farms recorded both the birth date and cull date for 23,881 cows. The average lifespan of culls is 4.9 years and the average productive life of these dairy cows is 2.7 years. Among the 65 farms, the 25% best performing farms have an average longevity of 5.6 years, while the 25% worst performing farms have an averaged longevity of 4.0 years.

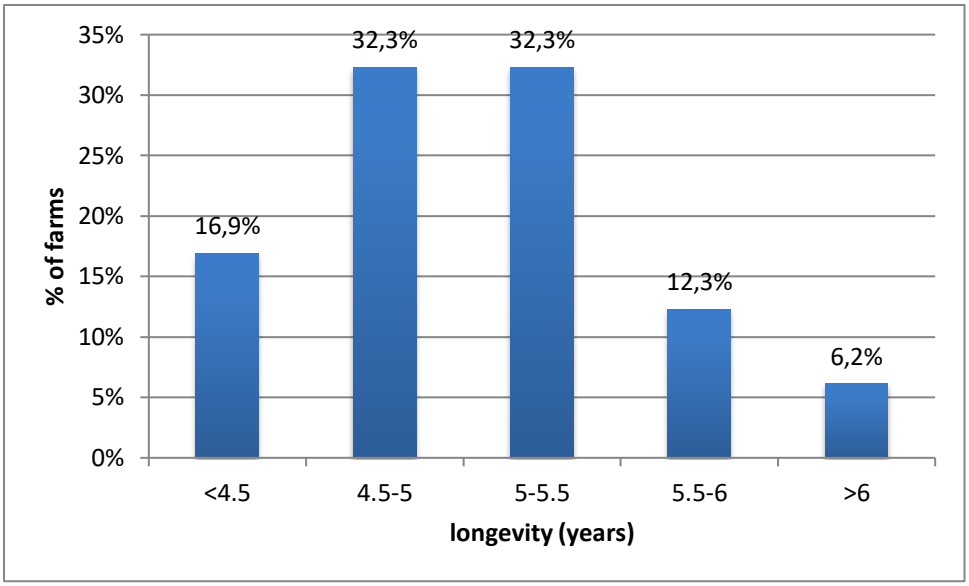

Figure 4. Distribution of 65 farms across longevity classes (2014)

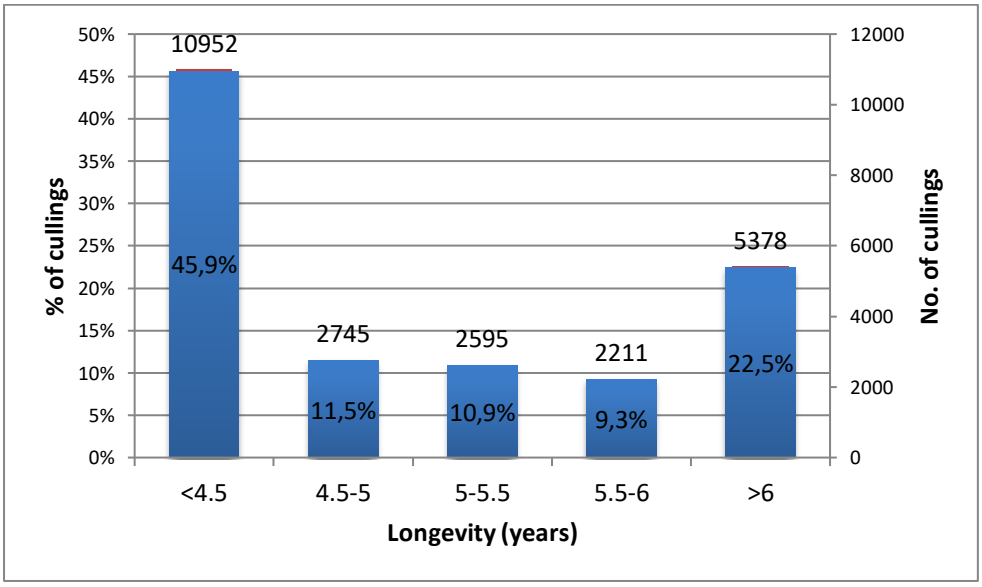

Figure 5. Distribution of 23,881 culling cows across longevity classes (2014)

Figure 4 shows that 6.2% of the 65 farms have a longevity of more than 6 years, while the cow longevity in 16.9% of these farms is lower than 4.5 years. 49.2% of the farms have a longevity of less than 5 years in figure 4, while figure 5 shows that more than 57% of culling cows leave the herd before they reach the age of 5 years old. This difference is caused by the larger average herd size of the farms in the two low longevity classes in figure 4. However, 22.5% of culling cows leave the herd after 6 years old.

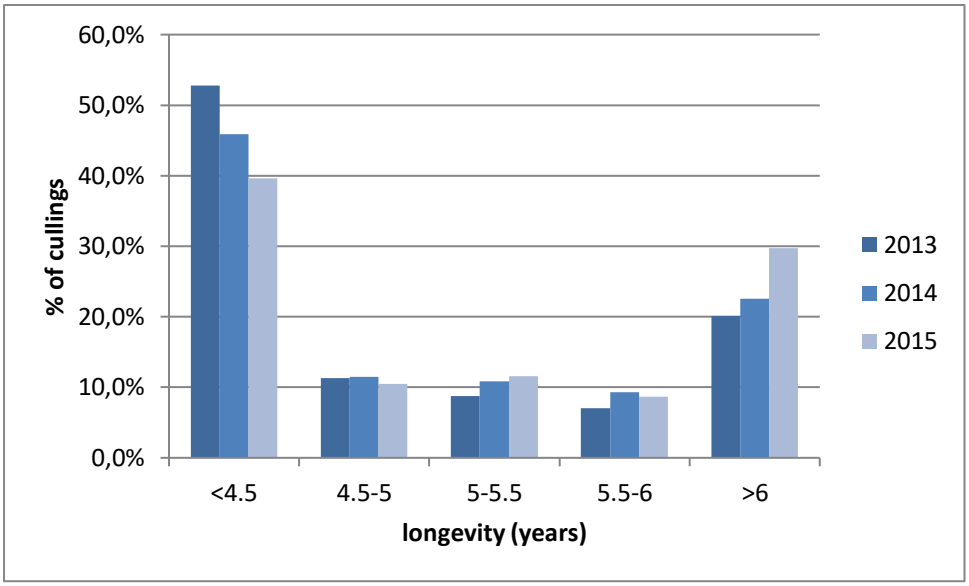

Figure 6. Distribution of culling cows across longevity classes in 3 years

In figure 6, the annual variation in the percentage of culling cows shows that more cows leave the herd after 6 years old and less cows were culled before the age of 4.5.

Figures 4 and 5 both show quite some potential to improve cow longevity in China, while figure 6, apparently, indicate the improvement in China cow longevity.

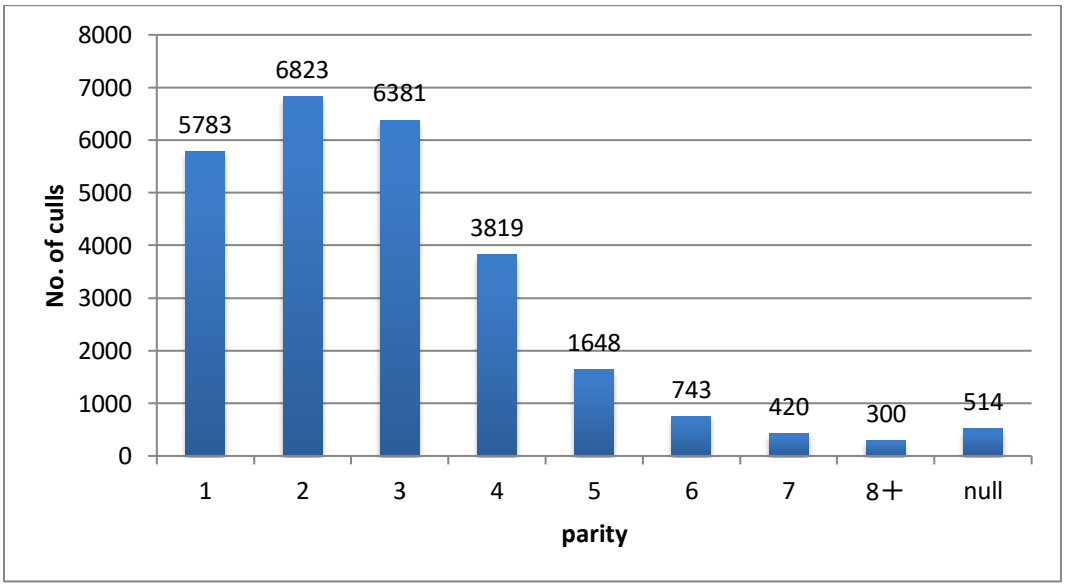

Figure 7. Number of all culls by parity (26,431 culls)

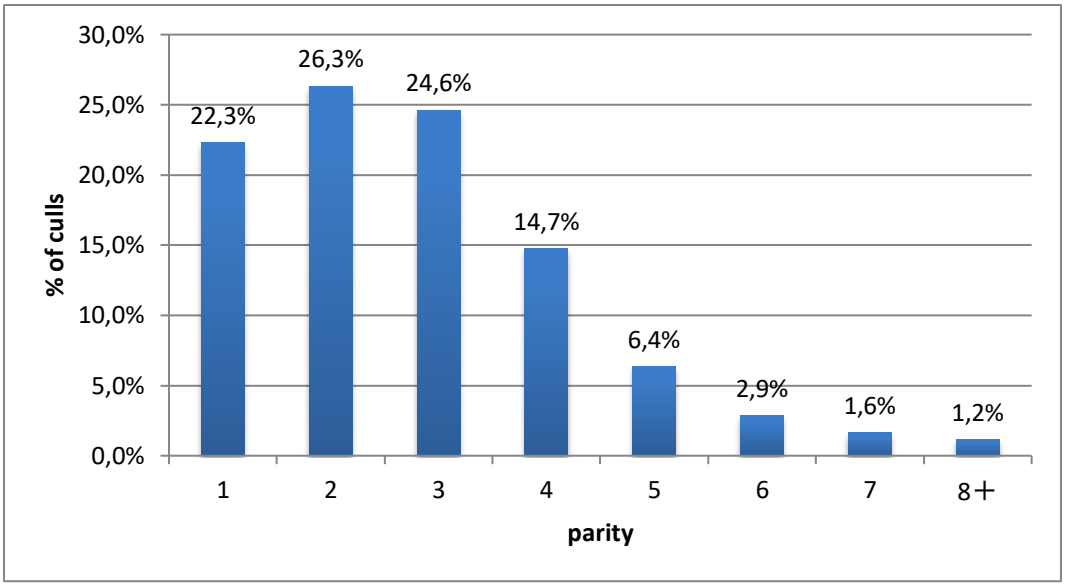

Figure 8. Percentage of all culls by parity (25,917 culls)

Figure 7 shows the distribution of 26,341 culls by parity and there were 514 culling cows with no parity recording. And figure 8 shows that among the 25,917 culled cows, more than 73% of them are culled in the first 3 lactations and the highest percentage of cullings is in parity 2 with 26.3% of all cullings. This division of cullings about parity leads to an average parity of culling of 2.7.

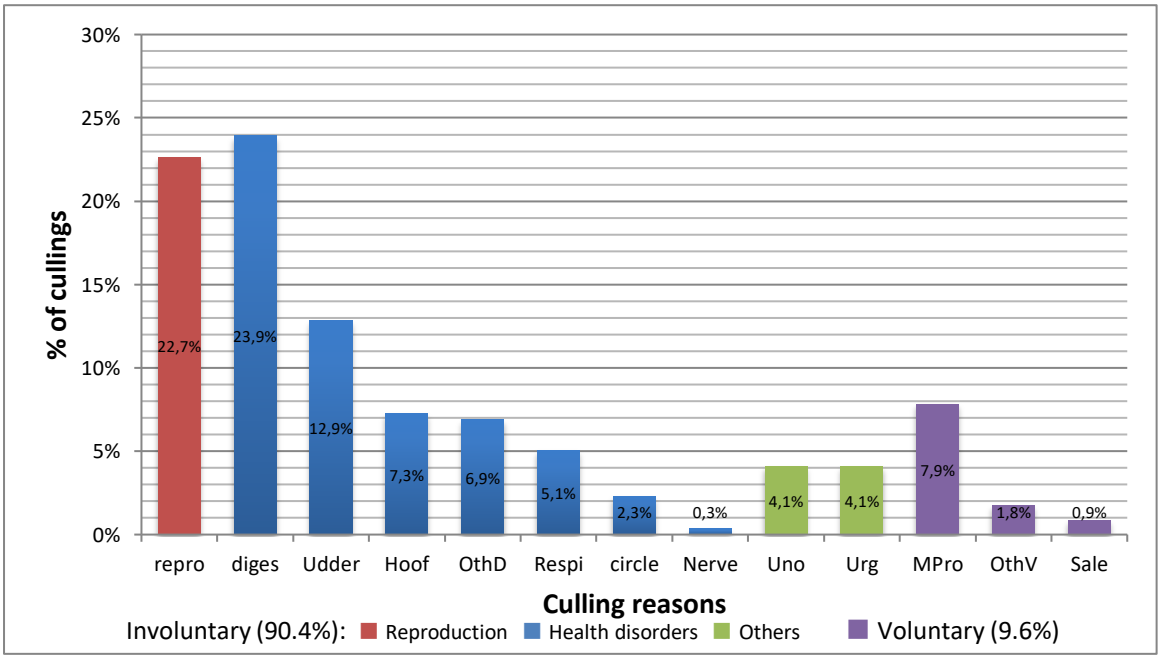

Figure 9. Reasons for culling (n = 25,920 cullings)

The most-frequent primary culling reasons were "Diges" (digestive system disorders and metabolic disorders), "Repro"(infertility or reproduction problems), and "Udder" (udder-related disorders, such as mastitis and teat injuries), which accounted, respectively, for 23.9%, 22.7% and 12.9% of total cullings. More than 81% of the cullings were declared in relation to health or reproductive disorders. Among these health related culling reasons, "Hoof" (hoof diseases) is also important to note, accounting for 7.3%.

However, a larger percentage of cows (4.1%) were removed from the herd due to "Uno" (unknown or unspecified) culling reasons. This may indicate missing data recording in cow files, particularly in some

farms in China. There have been studies trying to ascertain why cows die on farm and from which diseases, but the information gathering is hindered by inaccurate and inconsistent data entry.

”Urg”（urgency）is also an important reason for culling. 4.1% of culled cows were sudden death or accidental injury, which exposed several problems in farm management.

Dairy cows, experiencing a disease or a reproductive disorder, are exposed to higher culling risks. This category of culls is usually designated as `involuntarily (or forced) culled cows', in contrast to all the other culls or sales, which are designated as `voluntarily (or selected) culled cows'. In Figure 9, only 8.83% were voluntarily culled cows and the highest voluntary or “selected” reason for culling is “MPro” (Low milk production) at 7.9%. That might show us farmers hardly cull their cows, unless the cows can’t bring benefits any more.

Possible reasons of fluctuation in culling rate may be the levels of milk production and milk and beef prices. Some farm managers suggest that these factors determine their culling decisions. So farmers may cull more cows in times of low milk production, low milk prices, and/or high beef prices. Some first results of our analysis show a negative relationship between milk price and culling rate. As the milk price drops, the culling rate increases. It means that farm managers tend to remove more cows from the herd in times of low milk price, due to unprofitable production.

4. International differences in average productive life

Table 4. Productive life of dairy cows in some countries specialized in dairy production

Country	**Average productive life***
New Zealand	4.2
United Kingdom	3.9
The Netherlands	3.7
Poland	3.3[4]
France	3.2[5]
China	2.7[6]
USA	2.7[7]
Canada	2.7[8]
Israel	2.5

*Productive life = time span between first calving and culling
Source: FAO[9]

The great variation in Table 4 between all these countries in which Holstein-Friesian-type cows dominate the dairy cow population, suggest that farming systems play a role in determining longevity. Apparently dairy cows live longer in countries with grass-based farming systems (in New Zealand, United Kingdom and the Netherlands large part of the farms have grass based farming systems). One may add that the average production per cow per day is usually also lower on farms with grass based farming systems compared to cows in confinement systems. This could also lead to the assumption that these cows in grass based farming systems might be exposed to less metabolic stress resulting in a longer productive life. In USA, Canada and Israel the average production per cow per day is relatively high compared to the other countries in the table.

5. Sector approach to improve longevity in the Netherlands

As part of its Sustainable Dairy Chain Agenda the Dutch dairy sector has explored the possibilities to increase longevity by improving health and welfare of dairy cattle. A qualitative expert approach to

[4] Analysis of longevity and reasons for culling high-yielding cows, Adam Oler et al., 2012
[5] Reasons for culling in French Holstein cows, H. Seegers and F. Beaudeau, 1998
[6] Preliminary results Ma Jiaying and Cao Zhijun, 2016
[7] USDA. Dairy statistics[DB/OL]. 2013. Available at http://future.aae.wisc.edu.
[8] Source: CanWest DHI and Valacta
[9] FAO, 2013. Available at http://faostat.fao.org/site/569/DesktopDefault.aspx?PageID=569#ancor

appoint bottlenecks and solutions resulted in four key proposals to stimulate dairy farmers to increase in longevity at farm level[10]:

1. Create awareness about the added value of longer living cows by demonstrating results of farms that have increased longevity in the past and by using a tool that can forecast the financial results of adaptations in farming practices.
2. Develop a Plan-Do-Check-Adjust (PDCA) approach and teach farmers how to work at farm level on their bottlenecks to increase animal health and welfare. The PDCA approach requires from farmers to appoint the performance indexes they want to improve and challenges them to define targets, actions and deadlines to achieve the desired higher level of animal health and welfare. Working this way is expected to increase longevity and the financial results of the farm.
3. Create incentives to stimulate farmers to work on longevity. These incentives can comprise: workshops or trainings, bonus milk price or extra permits or licenses for farmers with higher average longevity level of the herd.
4. Organize trainings about better labour organization to avoid that a high work load will result in suboptimal animal care.

Till so far the dairy sector has made a start with implementing proposals 2 and 3. The other proposals are not yet turned into actions. Proposal 2 has also led to the development of nine key themes to improve health and longevity: longevity, production, culling, transition management, udder health, fertility, claw health, rearing of young stock and use of antibiotics. For each of these themes experts have recommended performance indexes that can be combined to two one-page reports: one report for annual evaluation and another report for monthly monitoring and evaluation. The performance indexes for this monthly report are listed in Table 5.

Table 5. Proposal for performance indexes for monthly farm report to monitor and evaluate dairy herd performance

	Theme	**Performance indexes (farm averages)**
1	Production	• Milk production per cow (in real kg and in age and calving season corrected kg) • Fat and protein content • Urea content milk • Milk production, fat and protein content, age and calving season corrected milk for 5 groups (categorized for days in milk) • Idem for 3 groups categorized by parity (first calf, second calf and third calf and higer)
2	Transition management	• % cows with %fat / %protein > 1.25 • % cows scoring positive for ketose based on milk sample • % cows with %fat / %protein < 1 • % transition disease incidences
3	Udder health	• Cell count bulk tank • % mastitis incidences • % successfully treated during lactation • % New cows with increased cell count during lactation
4	Fertility	• Days open • Inseminations per cow
5	Claw health	• % incidendes of claw disorders
6	Rearing of young stock	• Age at first insemination • Inseminations per heifer • % diseases calves (during period 0-60 days)
7	Treatment with antibiotics	• Animal days-dosage-number

[10] Zijlstra et al., 2013

This report is made to provide farm managers with a quantified insight into the status of their farm for these themes. It also offers benchmarking possibilities by comparing farm figures with average performance indexes of peer groups. And in the Netherlands farmers, veterinarians and other consultants are also stimulated to formulate their own targets for some key performance indexes. These indexes are also valuable in the process to of the PDCA approach mentioned before. Improving indexes might require the introduction or adjustment of certain standard operating procedures that can support the right actions needed to move in the desired direction.

6. Recommendations to improve longevity in China

In China, there is almost no attention to cow longevity. Farmers and farm managers are prone to put all their reflection and energy on how to make profits from cows and how to reach milk production targets. So the first thing we may do is communicating farmers and farm managers the importance of increasing longevity of cows.

Surveys show that the major reasons for culling are reproduction failure, mastitis, and lameness. Our data also show the similar conclusion that reproduction disorders, udder-related disorders, digestive system disorders and hoof diseases are assured known causes of culling in China, accounting for 68% of all cullings. For most average herds these are the areas requiring attention to improve herd longevity.

Before, we have mentioned that milk production influences farm managers' decisions. In fact, milk production is intimately connected to fertility and udder health. Hoof health and rumen health will also indirectly affect milk production. If a cow does not breed back and calve again, she will gradually (or suddenly) drop in production to levels beneath profitability. A mastitis cow produces less milk, if subclinical, or goes into the hospital group and incurs additional medical treatment and labor costs if clinical. Severe or chronic infections are costly.

If we want to increase cow longevity, we should improve the health and welfare of dairy cattle and minimize kinds of diseases of our cows.

The first step in improving longevity within a herd is to establish the current position by benchmarking key figures for the herd against group averages. Once a factor has been measured, it can be managed and priority areas can be identified for attention. Prepare a list of all culled cows in the last year. For each one identify the reason for leaving from the list. Then calculate some following indexes, such as:

1. Culling rate
   Take the total number of cullings over the 12-month period and divide by the rolling average herd size for the same period.
2. The percentages leaving for each of the main culling reasons
   Calculated by taking the totals for each reason divided by the total number of culls.
3. Average lactation age (average parity)
   Calculated using the latest set of records for the herd.
4. Involuntary or forced culling rate
   The total number of cullings for an involuntary reason divided by the rolling average herd size.

Using the calculated figures for the herd and comparing data with group averages, a farmer will find the relative situation. If this relative position is suboptimal, then he can select a herd strategy to achieve his optimal position (reduce overall culling rate or reduce the level of a specific reason). All the problems cannot be fixed at once. Draw up a priority action list and address the biggest problems first:

- Identify the major reasons cows are getting culled and generate possible solutions. If all culling reasons are higher than expectation, start from focusing on one or two to determine causes and begin action plans to correct the problems. Further investigation is needed once a category has been selected to better understand reasons for culling and generate possible solutions
- If the total involuntary culling rate is greater than average, or the involuntary cullings are over 60%[11] of all cullings or if the involuntary culling rate is higher than the farm target, there is

[11] Uk M D C. Longevity - controlling culling to improve herd profitability.[J]. Publication - Milk Development Council, 2000.

opportunity to improve it. We can set an achievable guideline. However, the goal should be to minimize the involuntary cull rate.

- Cows leaving the herd when less than 30 days in milk (DIM) usually are cows that have died or have serious metabolic or infectious disease problems at calving. It is important to distinguish between cows that are culled and cows that die. Analyse the records to determine early lactation cullings and the broad categories causing cows to leave.
  The farmer should develop guidelines to support decisions about culling, especially for decisions in early stage of lactation (e.g less than 100 DIM)
- Develop a a farm specific action plan and set up a monitoring plan. Work with the appropriate team of advisors and employees to develop an action plan based on your on-farm investigations and also some key monitors to determine if your plan is working. Make modifications to the plan if it does not deliver the expected results.

7. Conclusions

1. Longevity as indicator
   In the Netherlands high longevity is considered as indicator for health and welfare of dairy cows. In China longevity is more connected to sufficient available young stock and milk price. In case of lack of young stock and high milk prices, longevity will increase.
2. Reasons for culling
   The most important culling reasons for dairy cows in both countries are almost the same. Reproduction problems, udder problems and hoof problems are in the top 4 in both countries. The difference in top 4 reasons are: digestive problems on place 2 in China and other (clustered) health problems on place 4 in the Netherlands.
3. Average productive life
   Average productive life of dairy cows is 3.7 years in the Netherlands and first data of 19 Chinese dairy farms with an average herd size of 813 cows show an average productive life of 3.0 years. This productive life is exclusive the rearing period of about 2 years.
4. Recommendations to improve longevity
   In both countries we suggest to improve longevity by:
   a. Give the farmers clear insight into? their present longevity situation by benchmarking based on data about longevity, culling reasons and health problems.
   b. Make a priority list of targets on animal health and welfare that will support minimizing involuntary culling (action plan).
   c. Make a list of measures or best practices to adopt and apply them.
   d. Monitor results and modify the plan to make a better fit to the specific farm situation.

Acknowledgement

We thank Erwin Koenen and René van der Linde of CRV for sharing data about culling reasons in the Netherlands and for their comments on draft versions of this paper.

The SDDDC project

In November 2013 China Agricultural University (CAU), Wageningen University and Research Centre and FrieslandCampina launched the Sino-Dutch Dairy Development Centre (SDDDC) in Beijing. In December 2014 also CRV and Beijing Sino Farm Livestock Technology joined the SDDDC followed by the Rabobank in March 2015. The objective of the Centre is to improve dairy production, safety and quality levels throughout the entire dairy chain in China based on Dutch expertise.

The Netherlands has over a century of experience in producing a large quantity of high quality milk on a limited area of farmland. The SDDDC's activities focus on sharing Dutch dairy expertise with Chinese experts and decision makers in dairy research and the dairy industry.

At present, China's dairy market is facing major challenges. China is experiencing a rapidly growing demand for dairy products, but has limited availability of arable land. At the same time, the focus of the dairy sector is shifting from quantity expansion to quality improvement and profitability increase. That is why it is key to improve milk yield and milk quality. Besides, food quality and food safety have become important priorities for the Chinese government.

In support of the situation, problems and trends in the Chinese dairy industry, the SDDDC undertakes activities that can contribute to improving dairy safety and quality in China (based on a 'Grass to Glass' chain approach).

The SDDDC aims to contribute to improving production, quality and safety throughout the Chinese dairy sector. With an annual budget of over 10 million RMB the centre undertakes a variety of activities: research and innovation, cultivating academic talent, trainings and field visits, running expertise centres (demo farms) and other stakeholder engagement activities.

Wageningen UR and CAU work closely together on the topic farm and data management for the improvement of dairy production in China. Objective of this project is to develop "Best Practices" and knowledge to strengthen the dairy farm management capacities of Chinese dairy farmers. Specific focus is to identify, analyse and report best practices of farm management in relationship to longevity and life time performance.

Wageningen/Beijing May, 2016

This paper was the result of a joint project of Wageningen Livestock Research and China Agricultural University within the Sino-Dutch Dairy Development Centre (SDDDC) collaboration project.

This paper can be downloaded for free at https://edepot.wur.nl/408789

P.O. Box 338, 6700 AH Wageningen, The Netherlands
T +31 (0)317 48 39 53, E info: livestockresearch@wur.nl, www.wur.nl/livestock-research.
Wageningen Livestock Research is part of Wageningen University & Research