

From recording to the Danish total merit index

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Abstract

The organizations working in the Danish dairy cattle industry have used a common data processing centre since the start of the 70s and the recorded data have been integrated in one central database. The frequency of milk recorded cows is about 85%. The genetic evaluation of resistance to mastitis is based on records from about 50% of the milk recorded cows. For calf mortality, calving ease and female fertility records from about 80%, 65% and 55% of the milk recorded cows are included in the evaluations. New evaluations systems for diseases are currently being developed in order to utilize data more intensively.

1. Introduction

The organizations working in the Danish dairy cattle industry have used a common data processing centre since the start of the 70s and the recorded data have been integrated in one central database. The most important of these organisations are:

- Milk recording societies
- AI-organisations
- Breed societies
- Slaughterhouses, dairies and cooperative service organisations for economics, plant, and livestock production.

Besides, most veterinarians have contributed data to the common database since the early 90s. This central database has created the foundation for genetic evaluation of functional traits. Even if functional traits carry much weight in the breeding goal, the weight in the selection index and thus the genetic progress rely heavily on the reliability of the estimated breeding values. The number of records becomes very essential as most functional traits have low heritabilities.

The purpose of this paper is to describe the Danish system for registration and evaluation of functional traits with emphasis on traits not related to milk recording. The traits are those related to:

- Calving: mortality, calving ease and size/weight of calf

- Female fertility
- Resistance to diseases

2. Status of Danish evaluation system

Figure 1 gives a survey of the current Danish evaluation system. Currently, a total of 41 traits are evaluated. The 41 estimates of breeding values are summarized in 10 sub-indices and a total merit index. Among the 10 sub-indices 5 describe conformation and management traits which are all evaluated by the same type of model. Six different groups of traits are evaluated

- Milk production
- Beef production
- Fertility
- Calving performance
- Resistance to mastitis
- Conformation.

BLUP sire models are used to evaluate all traits except milk production and conformation traits where Animal Models are used.

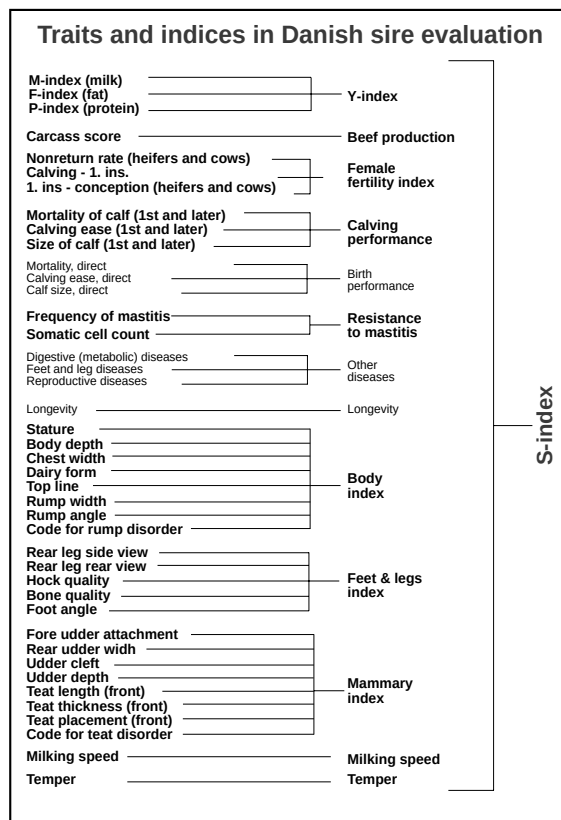


Figure 1. Survey of current genetic evaluation of dairy cattle in Denmark

Currently, an evaluation system for other diseases than mastitis is being developed as well as an evaluation system for functional longevity. This work may lead to the revision of the composition of the sub-indices showed in figure 1. The results of this revision will probably also be influenced by the conclusion of the work in the GIFT-group.

Another group of traits that could easily be included in the Danish total merit index are the direct calving performance traits (birth performance). These traits are evaluated simultaneously with maternal calving performance. They are not included in the total merit index but are published as supplementary breeding values and mostly used to assign sires for heifer inseminations.

3. Survey of recording system

Information on individuals is collected from 6 different sources.

Government (EU)

Since January 1998 some basic information on all cattle has to be reported due to an EU-regulation. This information is recorded by the farmers but processed by the milk recording societies and the data is included in the common database:

- ID, sex, date of birth, trade, and culling as a minimum
- In addition all the basic information recorded by the milk recording societies can be included

Milk recording societies

Technicians and farmers in combination record the information. The following three types of information are required for milk recorded herds:

- ID, pedigree, basic dates and events on calving, dry off, trade and culling
- Mortality of calves
- Milk production including concentration of fat, protein and somatic cells

Additionally, the following information may be supplied:

- Calving ease - calf weight or size
- Non AI-breedings, AI-breedings by farmers
- Treatment of diseases by the farmer or recorded by the farmer
- Concentration of urea in milk
- Weights

AI-organisations

All events are recorded by AI-technicians.

- AI-breedings
- Treatment of reproductive disorders by AI-technician

Veterinarians

Disease recording is usually part of a health service programme offered by veterinarians.

- Treatment of diseases

National Committee on Cattle Husbandry

- Linear conformation traits are scored for daughters of AI-bulls

Slaughterhouses

Slaughterhouses approved for EUROP-classification transfer all results to the central database.

- Carcass weight
- EUROP-scores of carcass form
- Scoring of colour and fat cover
- Observed diseases and disorders

Up to now the genetic evaluation of all traits has been based on the data from the milk recorded herds. Figure 2 shows the development in the percentage of milk recorded cows. In 1998, about 85% of all cows was milk recorded.

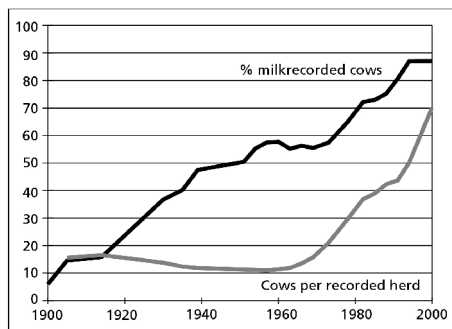


Figure 2. Milk recorded cows in Denmark (%)

In table 1 the number of records included in the genetic evaluations of Danish Holsteins is shown. The results are based on the number of calvings in 1997. In general, data are excluded or missing in the genetic evaluation for the following reasons:

- Missing identification of sire for traits evaluated by sire models
- Editing due to trait definition, e.g. milk yield in lactations of at least 45 days, frequency of mastitis in lactations of at least 180 days
- Editing of data in order to eliminate unreliable data or other irregularities.
- Trait not observed

The frequency of data included in the evaluation of milk production traits is about 93% for first lactations and somewhat lower for later lactations because only second and third lactations are included.

For beef production only data on about 40% of the bull calves are included in 1997 but this number is expected to increase rapidly during the next couple of year and reach a level of 60 - 70%.

For female fertility the utilization of data is low because a substantial part of the cows are not bred or bred by non-AI-breedings. Also many irregularities are observed in the fertility records.

Table 1. Survey of records available for genetic evaluation in 1997

	1 st lactation	% of milk recorded	Later lactations	% of milk recorded
Milk recorded	166881	-	277174	-
Milk production	154615	93	173620	63
Calving: mortality	128993	77	217872	79
Calving ease	107579	64	179974	65
Fertility: Calv. - 1 st ins.	95314	57	147238	53
Fertility: 1 st - last ins.*	94225	56	144778	52
Somatic cell count	127260	76	-	-
Mastitis	87516	52	-	-
Conformation	18465	11	-	-
Beef production	Records on 88,414 bull calves , approx. 40% of total			

* Heifers: approx. 120,000 observations, including culled heifers

About 75% of the milk recorded cows are included in the evaluation of somatic cell count due to the requirement of at least 180 days in milk. The same editing rules are applied to disease records but due to missing records only about 50% of the cows is included.

For calving performance traits both sire and maternal grandsire are to identified. Besides all twins and calves born by embryo transfer are deleted. This reduces the number of observations to about 78% for mortality and to 65% for calving ease. The difference between mortality and calving ease is only due to missing observation of calving ease.

Diseases and calving ease

In 1984 the milk recording system was changed such that new animals were mainly admitted to the database when the identity of a live-born calf was reported as part of the recording of a calving. Otherwise, the destiny of the calves must be reported. When the basic information on a calving and the destiny of the calf is reported, it is possible to supply information on calving ease and calf size. Table 2 shows that this information was given for 50% of the calves at the outset in 1984. Now this information is supplied for around 80% of the calves and the missing information is nearly equally distributed on stillborn and live-born calves.

Table 2. Intensity of registration for voluntary recording of calving ease and treatment of diseases in Danish Holstein

Year	Calving ease(%)	Calf size (%)	Disease records (%)
1985	54.2	57.5	-
1986	65.2	68.9	-
1987	70.5	74	-
1988	73.5	77.1	-
1989	73.9	77.3	-
1990	74.3	76.4	22.8
1991	75.9	76.5	42.3
1992	77.2	79.7	51.8
1993	77.4	80	58.6
1994	77.3	80.4	60.2
1995	77.5	80.9	63.4
1996	78.2	81.4	64.5
1997	79.4	79.3	68.8
1998	81.7	83.3	70.6

Table 2 also shows the development in intensity of disease recording. The veterinarians supply information directly into the central database or through the local milk recording society, usually as part of a health service programme. This service has been offered from the start of 1990. Besides, treatments made by the farmer can be reported directly to the milk recording society.

The recording of disease treatments is complicated to validate, because missing observations may be due to either healthy cows requiring no treatments or to missing or partly missing recording. The results in table 2 show the number of cows after a validation process that eliminates records from herds that do not participate regularly in the recording program. In 1998, 70% of all milk recorded cows was from herds participating in disease recording.

4. Selection of sires

It is a common practise to put a minimum limit to the reliability (40-60%) of the EBVs before they are published. As a consequence, the EBVs for the different trait groups of a sire will be published during a time period of 2-6 months. The EBV's from the evaluation of direct calving performance will appear about 2-3 years after the birth of the sire. The next group of traits to be published is beef production traits (3-4 years). Then the traits based on first lactation records of daughters will become available (4-5 years). The first results are usually the EBV for milk production traits.

The average of the remaining groups of traits compared to milk production is :

- Conformation: 0.9 month
- Female fertility 1.6 months
- Calving performance 1.9 months
- Resistance to mastitis: 2.8 months

This delay could be critical in a practical selection system if bulls are selected or disposed of when the results on milk and conformation traits are available - but before

calving performance, female fertility and resistance to diseases are available. This could be avoided if the minimum limit for publishing of the EBVs was removed. On the other hand, the limits reduce the criticism of the genetic evaluation systems.

The negative effect of the delay in publication of EBVs for functional traits are somewhat encountered by more frequent evaluation. All the functional traits are currently evaluated 4 times a year in Denmark. Milk production and conformation traits are evaluated 8 times a year.

5. Future development

For mastitis and somatic cell count (and conformations traits) it is obvious to improve the evaluation by including information from later lactations. For the other disease traits it is even more important to utilize all possible information because the heritability of these traits are generally lower than those of mastitis (Nielsen et al.; 1999) and currently we have no trait like somatic cell count to support the genetic evaluation. As mentioned a new evaluation system for other diseases than mastitis is being developed. Data from later lactations will be included in this evaluation

For disease traits it is advantageous to include multiple traits evaluation (Nielsen et al.; 1996) presented results for a multiple trait evaluation of resistance to mastitis (mastitis and somatic cell count from up to 3 lactations and some conformations traits in 1st lactation). This method gave an increase in reliability of up to 10% compared to the current Danish evaluation system. This analysis was based on a frequency of disease recording of 60% compared to the current 70%. EBVs for resistance to mastitis based on somatic cell count only reduced the reliability by more than 30%. Next year the genetic evaluation of resistance to mastitis will be changed to a multi-trait evaluation that includes information from later lactations on frequency of mastitis, somatic cell count and some conformation traits.

A test day model for somatic cell count will increase the utilization of data to the same level as for milk yields traits. For disease traits models equivalent to the survival model will increase the utilization of data.

Using information from crossbred cows is also a possibility as well as utilization of information from not milk recorded herds (but milk producing) on calving performance, fertility, diseases and beef production traits. A substantial part of the bull calves of dairy breed is reared in specialized beef production herds.

As herd size increases (currently 70 cows /herd) we may expect that even more herds will participate in milk recording if the costs of recording can be kept at a minimum and that the services provided can satisfy the producers. Otherwise, decentralized recording systems may easily be implemented in these large herds.

There has been an increasing interest in using the results from the genetic evaluation in management information system. Lately, the herd-year-season effects for milk production traits have been published and it has been considered to publish the changes over time. This service could easily be extended to other traits as well. However, this integration of genetic evaluation and management information is only possible if the genetic evaluations are very frequent.

The extended lactation records have been used to predict production for many years. When the test-day model is introduced, the accuracy of this prediction can probably be increased considerably.

6. Conclusion

The frequency of milk recorded and AI-bred cows is high in Denmark. Our efforts will be directed towards the improvement of quality and the utilization of existing data rather than to increase the number of recorded cows. Especially frequency of disease recording and the quality of fertility recording still needs some improvement. Also, it is important to

keep the central database open to all types of information generated in the dairy industry. In genetic evaluation the main effort is directed toward the utilization of existing data by including more data and implementing more sophisticated evaluation models.

References

Nielsen, U. S.; Pedersen, G. Aa.; Pedersen, J., 1996 *Indices for resistance against mastitis* *Interbull Bulletin no. 14*: 161-166

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Table 3. Number of sires with published sub-indices, October 1999, Danish Holsteins

Year of birth	Month	No. of sires	Yield	Beef production	Mat. calving perf.	Female fertility	Resist. to mastitis	Conformation traits	<i>Direct calving perf.</i>
1994	1 - 6	158	158	158	156	158	155	158	158
	7	33	33	33	31	33	33	33	33
	8	24	24	24	19	22	22	23	24
	9	24	24	24	22	24	20	23	24
	10	37	37	37	31	33	31	35	37
	11	29	29	29	24	27	16	29	28
	12	35	33	35	20	24	12	31	33
1995	1	44	42	44	18	27	5	37	44
	2	34	25	34	7	12	1	22	34
	3	28	23	28	3	5	0	13	28
	4	35	24	35	1	2	0	9	35
	5	20	7	20	0	0	0	2	20
	6	22	0	22	0	0	0	1	22
	36500	234	0	234	0	0	0	1	234
1996	All	364	0	171	0	0	0	0	364