Health, Longevity and Economic Merit – Key Words in the Nordic Cattle Breeding Goal

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Summary

In October 2008 the joint Nordic total merit index named **N**ordic **T**otal **M**erit (**NTM**) for the Nordic Red breeds, Holstein and Jersey in Sweden, Finland and Denmark was published for the first time. The NTM-index is composed of joint Nordic EBV's for the different trait groups and was driven by a wish from Nordic Cattle Genetic Evaluation to get one common breeding goal across the three countries. Furthermore the formation of a farmer owned AI-company (Viking Genetics) across Denmark and Sweden and from 2010 also Finland supported the development. Today all bulls and cows in Sweden, Finland and Denmark have the same total merit index in all three countries. In that way, it is possible to compare all bulls and cows from these countries in relation to genetic superiority for economic performance.

The common breeding goal focuses on profitable cows with improved functional traits. Future expectations for dairy production with increased focus on animal welfare have been taken into consideration in the formation of the NTM-index. Significant emphasis has been put on fertility, calving traits, mammary system and health. The overall goal for all breeds in Finland, Sweden and Denmark is therefore still cows with improved genetic level for yield and functional traits resulting in improved economic profit for the dairy farmer.

Gesundheit, Langlebigkeit und Wirtschaftlichkeit – Schlüsselwörter in dem nordischen Rinderzuchtziel

Im Oktober 2008 wurde zum ersten Mal der gemeinsame nordische Gesamtindex NTM (Nordic Total Merit) für die nordischen roten Rassen, Holstein und Jersey in Schweden, Finnland und Dänemark veröffentlicht. Der neue Index besteht aus den gemeinsamen nordischen Zuchtwerten für die verschiedenen Merkmalsgruppen, und seine Entwicklung wurde vor allem von Nordic Cattle Genetic Evaluation vorangetrieben. Die Gründung von Vikings Genetics als länderübergreifendes Zuchtunternehmen für Schweden und Dänemark Anfang 2008 (Finnland wird Anfang 2010 beitreten) unterstützte diese Entwicklung. Heute haben alle Bullen und Kühe in Schweden, Finnland und Dänemark den gleichen Zuchtwert in allen drei Ländern. Dadurch ist es möglich geworden, alle Bullen und Kühe in Bezug auf ihre genetische Überlegenheit ihrer wirtschaftlichen Leistung über die drei Ländergrenzen hinweg zu vergleichen.

Das gemeinsame Zuchtziel konzentriert sich auf wirtschaftliche Kühe mit verbesserten funktionalen Eigenschaften. Als der NTM-Index entwickelt wurde, wurde auf die zukünftigen Erwartungen an die Milchproduktion mit erhöhtem Schwerpunkt auf das Wohlbefinden der Tiere Rücksicht genommen. Fruchtbarkeit, Kalbeeigenschaften, das Euter und Gesundheit wurden dabei verstärkt berücksichtigt. Das übergeordnete Ziel für alle Rassen in Finnland, Schweden und Dänemark sind deshalb immer noch Kühe mit einem verbesserten genetischen Niveau sowohl für Milchleistung und als auch für funktionale Eigenschaften, die dem Landwirt einen hohen wirtschaftlichen Ertrag sichern.

Santé, longévité et économie – les mots clés de l'objectif de sélection des bovins des pays nordiques.
En octobre 2008, l'index de synthèse conjoint aux pays nordiques (Nordic Total Merit, NTM) a été publié pour la première fois pour les races rouges nordiques, la Holstein et la Jersey, en Suède, Finlande et au Danemark. L'index NTM est composé des évaluations conjointes des 3 pays scandinaves pour les différents groupes de caractères, et résulte de la formation de Viking Genetics entre la Suède, la Finlande (2010) et le Danemark au début de l'année 2008. Aujourd'hui, tous les taureaux et toutes les vaches de Suède, Finlande et du Danemark ont le même index de synthèse NTM dans les 3 pays. Il est donc possible de comparer directement les taureaux et les vaches des 3 pays sur leur valeur génétique et leur performance économique.

L'objectif de sélection commun recherche des vaches profitables, présentant des caractères de fonctionnalité supérieurs. Les souhaits de la production laitière, avec le poids croissant du bien-être animal, ont été pris en compte dans l'élaboration de la formule de l'index NTM. Un poids important a été mis sur la fertilité, la facilité de vêlage, les qualités de mamelle et de santé. L'objectif global de l'ensemble des races laitières en Suède, Finlande et au Danemark, est une vache de haut niveau génétique pour les critères de production et de fonctionnalité, aboutissant à un meilleur résultat économique pour le producteur laitier.

Total merit indices
The idea of a total merit index that includes all traits of economic importance has been practised in the Nordic countries for many years and has now been adopted in many other countries. Studies show that the total merit indices in the Nordic countries have been quite similar for years. However, there were some minor differences between countries.

In the recent years, Nordic Cattle Genetic Evaluation (NCGE) has developed joint EBV's for the different trait groups. This means that most traits are evaluated on a joint Nordic basis and common evaluation of the last few traits will follow in the near future. Thus, a joint Nordic total merit index was a logical next step.

Solid calculations and political considerations
The development has been a two step procedure. During 2007, the economic basis for the NTM-index was calculated (Pedersen et al, 2008), and in January 2008 results were presented for farmer representatives in Sweden, Finland and Denmark. During winter and spring 2008, the results were evaluated from the perspectives of animal welfare, ethical views, environmental considerations and expectations to future production circumstances. In June 2008 the results were discussed once again, and the final composition of the NTM-index within Holstein, the Nordic Red breeds and Jersey was decided.

The observed level for the different traits and prices of input factors and dairy products at the beginning of 2007 were the basis for the calculations. The reason for using this period was that prices have been very fluctuating and unstable since then.

The index weights given to the sub indices in the NTM-index are primarily based on the economic value of each single trait. The economic value is the marginal value of genetic improvement of that trait – keeping the remaining traits constant. As an example, the value allocated to protein yield was calculated as the economic profit of improving protein yield by one kg from the present level. The most important factors determining this profit are of course feed prices, price of milk and marginal feed utilization. The same type of calculation was done for all other important traits, e.g. udder health, fertility, calving ease, conformation, meat production, other health traits and longevity.

The ratio between costs and income influences the economic values. For instance, increased feed prices compared to milk prices mean a lower economic weight on yield in the breeding goal and shift the balance from production traits towards functional traits.

Economic values were calculated for all breeds within the different production environments, i.e. biological assumptions were defined for each breed within each country. The economic values within breed groups across production environments were quite equal. It was therefore possible to construct the joint NTM-index. The starting point for the final joint NTM-index was of course the calculated economic values. Based on these economic values, discussions between national AI-organisations and national breed organisations very soon resulted in a joint Nordic NTM-index equal to the theoretical recommendations

Weights in the new NTM-index

The process including political considerations where expected changes in future production circumstances, animal welfare, ethical views and environmental considerations were taken into account, ended up in the index weights for the NTM-index given in Table 1.

Table 1. Weights for calculation of the NTM index from sub-indices, and the economic value per unit of the indices

Trait	Index weights for NTM	Economic value of an index unit, €
Yield	**0.75**	**7.61**
Growth	**0.06**	**0.61**
Fertility	**0.31**	**3.12**
Birth	**0.15**	**1.52**
Calving	**0.17**	**1.67**
Udder health	**0.35**	**3.50**
Oth. Diseases	**0.12**	**1.22**
Body	**0.00**	**0.00**
Feet & legs	**0.15**	**1.52**
Udder	**0.18**	**1.83**
Milk ability	**0.08**	**0.84**
Temperament	**0.03**	**0.30**
Longevity	**0.11**	**1.14**
NTM	**-**	**10.15**

The overall aim for Holstein in Finland, Sweden and Denmark constitutes still a high yielding cow with an improved genetic level for functional traits resulting in improved economic profit for the dairy farmer. The new NTM-index is not a revolution compared to the old national TMI indices, but it is an update based on solid theoretical calculations and expectations for the future. The breeding goals for the national Nordic cattle breeds have been on right track for many years. The new index can therefore be seen as a valuable adjustment. However, the most important change is that it is a joint Nordic index.

Publication of NTM

The average NTM in the base population is 0. The base includes all 3-5 years old cows, which have calved once. If the publication date is 15.05.2009, then the base includes cows born between 15.05.2004 and 15.05.2006.

All EBV´s are expressed with a standard deviation of 10. The standardization factors are calculated such that sires, which have an average progeny group size (weighted average across the 3 countries), have a standard deviation of 10. The standardization factors for all traits are calculated from two birth years of AI sires (1997-1998), which have full information from their first batch of daughters. Only sires that have EBVs with a reliability above the limits for official publication, are included in the standardization. The standardization factors are kept constant from evaluation to evaluation.

Genetic Gain - using the NTM index

The index weights described in the previous chapter do not effectively describe the genetic progress that can be obtained using TMI. However, genetic correlations between TMI and the sub-indices for AI-bulls could give an estimate for the obtained genetic progress for the traits in the breeding goal, even though there is a tendency towards overestimation of the genetic gain for low heritability traits using this method, because it ignores bull dam selection. Another disadvantage of this approach is its sensitivity to number of bulls included in the analyses and to the number of bull sires represented in the sample.

The figures shown in Table 2 present correlations between NTM and sub indices based on EBV's from 1332 progeny tested bulls Holstein born in 2001, 2002 and 2003 in Finland, Sweden and Denmark. As mentioned above, the correlations are quite rough. However, the correlations can be used as good indicators for the direction of the genetic progress. The correlations multiplied by 100 express the response in each trait in percentage of the maximum response, given that the particular trait was the only trait in the breeding goal. In the Nordic Total Merit Indices, considerable weight is put on health and reproduction traits. By selecting for the NTM, one will achieve a genetic progress in udder health of 46% of the maximum response given udder health was the only trait in the breeding goal (Table 2).Note that the NTM leads to progress for all traits groups in the NTM, with a given economic value. Selection based on NTM one can achieve a balanced genetic progress avoiding a decline in any of the functional traits.

Table 2. Correlations between NTM and EBVs for single trait groups

Trait	Correlation with NTM
Yield index	**0.49**
Growth	**0.00**
Fertility	**0.39**
Birth index	**0.28**
Calving index	**0.37**
Udder health	**0.46**
Oth. diseases	**0.47**
Body	**-0.04**
Feet & legs	**0.12**
Udder	**0.40**
Milk ability	**0.09**
Temperament	**0.03**
Longevity	**0.51**

Figure 1 shows the genetic trend per birth year for Holstein bulls per birth year. The genetic trend has been substantial across years and has given significant more profitable cows for Nordic farmers.

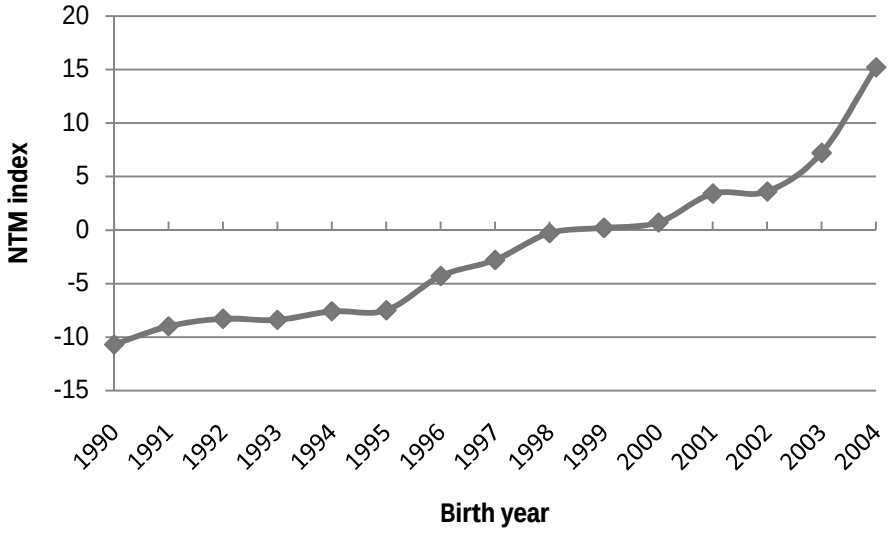

Figure 1. Genetic trend for NTM per birth year for Holstein AI bulls

Economic value of an index unit

The economic values presented in Table 1 represent the extra value per index unit created during the lifetime of an average animal. The values in Table 1 can be used to calculate the economic impact of different breeding schemes. But quite often we want to express the superiority of specific animals (often females). The index value given in Table 1 should be used if we want to express the total value of an average progeny. If we want to calculate the value of an index unit of the sire the value should be divided by 2 (assuming average dams). If the value of a specific heifer is wanted twice the value of an NTM in Table 2 must be used since the traits are only expressed in females. The value of one NTM index unit for a female is 20.29 € (2*10.15€). As an example, when comparing two Holstein heifers with a difference of 10 NTM units, the extra value of the best heifer is 202.9 € (10*20.29 €).

If we want to express the value of a daughter group per daughter (per index unit in the daughter group) the value per female has to be used. Using a Holstein bull, with an NTM index 10 units, higher than another bull, results in offspring with +5 NTM units on average. Then the economic merit amounts to 101.45 € (5*20.29€) per daughter.

Using the economic values in Table 1 and the genetic progress achieved in Figure 1, the genetic progress can be calculated to be about 150 Euros over the years 1993 to 2003 – quite a substantial contribution to an increased productivity.

Future outlook

The NTM was introduced as a joint Nordic Total Merit index in October 2008 and has been very well received by farmers, breed organizations, AI-industry and even people from outside the cattle breeding area focusing more on animal welfare aspects etc.

Genomic selection will presumably play a significant role in future cattle breeding. The pure economic values as such will not be changed by the introduction of genomic selection, but the possibilities to achieve genetic progress for functional traits might be improved compared to

traditional progeny testing schemes, since the reliability for functional traits seems to be relatively higher compared to production traits for Genomic breeding values compared with traditional breeding values (Lund & Su, 2009). Furthermore genomic selection opens for selection for functional traits on the female side, which hardly has been possible in the traditional breeding schemes due to low heritabilities.

References

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