NAV Nordisk Avlsværdi Vurdering
Nordic Cattle Genetic Evaluation

2018 Review of Nordic Total Merit Index Results 2

Proposed NTM weights and expected genetic response

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Content

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1 Index weights

Different NTM indices are compared in the following two chapters. To facilitate reading a brief description of each NTM index is shown in Table 1.1.

Table 1.1. Descriptions of different NTM indices that are analyzed in this and the following chapter.

Name of index	Description
Original 2008-2012	NTM index based on original proposed 2008 relative weights and later relative weights for claw health and young stock survival
Current NTM	As above but with relative weights adjusted after later decisions made by breeding organizations and the NAV board, e.g. added relative weight for udder conformation
Conv. NTM	NTM index based on proposed relative weights from the 2018 NTM project using conventional production circumstances
Conv. NTM udder	As conv. NTM but with relative weights for udder conformation equal to relative weights used in current NTM
Org. NTM	NTM index based on proposed relative weights from the 2018 NTM project using organic production circumstances

The economic values calculated for the conventional and organic scenarios form the basis for calculating two sets of index weights for the standardized sub-indices included in the NTM index, one for conventional production circumstances (Table 1.2) and one for organic (Table 1.5). The original 2008-2012 proposed weights are shown in Table 1.3. The weight for each sub-trait is shown relative to the yield index. For each sub-index, the value of each trait is calculated as the phenotypic value of one index unit multiplied by the economic value of one trait unit. It is a sub-index EBV expressed in euros (€EBV). From this, the value of the individual sub-indices can be calculated. For example, the value of one index unit for the yield index is €10.94 for HOL, €11.57 for RDC, and €9.36 for JER in the conventional scenario. In 2008, the value of one yield index unit was €7.61 for HOL, €8.33 for RDC, and $6.00 for JER. This is mainly caused by an increased assumption about the genetic standard deviation for protein and fat compared to 2008. For example, 77 % of the increased economic value per yield index unit in HOL is caused by changed standardization factors and 23 % by increased profit for milk. For the organic NTM the economic value of one yield index unit was €7.86, €8.26, and €6.68 for HOL, RDC, and JER, respectively.

Comments related to differences between the originally 2008-2012 proposed NTM weights and the newly proposed 2018 weights for conventional productions circumstances are shown in Table 1.4, i.e. where do differences originate from, the economic value of one trait unit or other circumstances like altered herd structure.

Table 1.2. Calculated relative weights across the NAV countries given to the individual sub-indices in the conv. NTM index. The weights are shown relative to the yield index.

Trait	HOL	RDC	JER
Yield index	1.00	1.00	1.00
Beef production	0.07	0.08	0.06
Fertility	0.38	0.29	0.25
Birth index	0.13	0.08	0.04
Calving index	0.13	0.08	0.06
Udder health	0.30	0.19	0.33
General health	0.13	0.09	0.11
Body	0.00	0.00	0.00
Feet & legs	0.04	0.05	0.07
Udder	0.05	0.06	0.13
Milkability	0.08	0.09	0.08
Temperament	0.04	0.03	0.02
Longevity	0.07	0.06	0.09
Claw health	0.09	0.06	0.04
Young stock survival	0.11	0.15	0.10

Table 1.3. Calculated relative weights across the NAV countries given to the individual sub-indices in the original 2008-2012 NTM index. The weights are shown relative to the yield index.

Trait	HOL	RDC	JER
Yield index	1.00	1.00	1.00
Beef production	0.08	0.11	0.03
Fertility	0.41	0.28	0.23
Birth index	0.20	0.15	0.07
Calving index	0.22	0.13	0.06
Udder health	0.46	0.34	0.51
General health	0.16	0.13	0.05
Body	0.00	0.00	0.00
Feet & legs	0.10	0.07	0.06
Udder	0.12	0.14	0.15
Milkability	0.11	0.07	0.11
Temperament	0.04	0.03	0.03
Longevity	0.15	0.09	0.14
Claw health	0.05	0.04	0.04
Young stock survival	0.18	0.24	0.14

Table 1.4. Short explanation of differences between original 2008-2012 and new conv. NTM weights related to either economic values or other matters.

Trait	Economic value (see first hand-out: "Results")	Other matters
Yield	23 % of the increased value for HOL is caused by larger profit per kg milk 13 % for RDC and 5 % for JER	Increased standardization factors due to increased estimates of genetic standard deviations of fat and protein – responsible for 77, 87, and 95 % of the increased value for HOL, RDC, and JER, respectively.
Beef production	Increased value caused by larger profit per animal especially because of higher profit for beef crosses than for pure dairy bull calves. Responsible for almost the entire increase – close to 100 % in JER.	Changed herd structure due to the use of sexed semen and beef semen and lower replacement cause a slightly higher number of slaughter animals
Fertility		Improvement cause increased number of slaughter animals instead of increased number of surplus heifers
Calving index, maternal	Slightly lower value.	Lower replacement rate cause decreased value in 1st parity and increased value in later parities Less difficult calvings in 1st parity because of lower proportion of bull calves. Beef crosses affects later parities more difficult calvings, especially JER → higher value
Birth index, direct	Slightly lower value	As for the maternal trait; however, values are lower in later parities because beef crosses only carry 50 % purebred genes
Udder health	Large decrease caused by lower treatment costs per case but only responsible for 6 % of decrease in HOL due to re-distribution of lactations, i.e. more later lactations.	Health agreement schemes means much lower veterinary costs; however, changed herd structure due to lower replacement rate means more cows in later parities which increased the overall economic value of the index
General health	Increase by approx. 40 %; lower treatment costs for some diseases but generally increased treatment costs	Health agreement schemes mean lower veterinary costs for some diseases, e.g. foot root
Body	No economic value	
Feet & legs	Slightly increased value (+14 %) caused by wage increase	Std. factors have decreased considerably
Udder	Slightly increased (+14 %)value caused by wage increase	Std. factors have decreased considerably for HOL and RDC and increased for JER
Milkability	Slightly increased value (+14 %) caused by wage increase	Std. factors unchanged
Temperament	Slightly increased value (+14%) caused by wage increase	Std. factors unchanged

Longevity	Large decrease. Responsible for almost 100 % of changes	Herd structure has changed → no surplus heifers (not profitable) but more beef animals for slaughter
Claw health	Very slight increase caused by wage increase	Country differences for some claw disorders explained by differences in proportion of severe cases
Young stock survival	Economic value of index unchanged	Different herd structure → fewer heifer calves are born but more beef crosses are born. Cross only carry 50 % of purebred genes

Regarding the large genetic standard deviations for milk, fat and protein, which results in relative large weight of yield in proposed conv. NTM, the NAV NTM group considers these to be at the high end. Before the January 2018 NAV Workshop extra analyses will be made to confirm the assumed figures. The results will be presented at the workshop.

Table 1.5 shows the relative NTM weights for org. NTM. Comments related to differences between proposed conventional and organic NTM weights are shown in Table 1.6. In general, the relative org. NTM weights are higher under organic production circumstances than for conv. NTM because the value of the yield index is lower because the marginal feed costs are higher. Herd structure is similar in the two production systems but health agreement schemes, enabling owner treatment of certain diseases, are not employed on organic farms. This increases the relative weight of the disease traits (udder health and general health) because veterinary costs are much higher.

Table 1.5. Calculated relative weights across the NAV countries given to the individual sub-indices in the org. NTM index. The weights are shown relative to the yield index.

Trait	HOL	RDC	JER
Yield index	1.00	1.00	1.00
Beef production	0.08	0.08	0.04
Fertility	0.47	0.36	0.27
Birth index	0.16	0.10	0.03
Calving index	0.16	0.11	0.05
Udder health	0.72	0.45	0.77
General health	0.23	0.17	0.23
Body	0.00	0.00	0.00
Feet & legs	0.05	0.07	0.09
Udder	0.07	0.09	0.18
Milkability	0.12	0.12	0.11
Temperament	0.05	0.04	0.03
Longevity	0.09	0.07	0.11
Claw health	0.14	0.08	0.05
Young stock survival	0.14	0.19	0.06

Table 1.6. Short explanation of differences between organic and conventional NTM weights

Trait	Economic value	Other matters
Yield	Lower value caused by increased marginal feed costs	Similar to conventional
Beef production	Similar to conventional for RDC and HOL. JER lower	Similar to conventional
Fertility	Almost similar to conventional	Similar to conventional
Calving index, maternal	Slight decrease caused by higher marginal feed costs for slaughter animals	Similar to conventional
Birth index, direct	Lower value especially for JER because of higher marginal feed costs for slaughter animals	Similar to conventional
Udder health	Much higher value	Health agreement schemes not employed → much higher veterinary costs
General health	Increased value	Health agreement schemes not employed → increased veterinary costs
Body Feet & legs Udder Milkability Temperament	No economic value Similar to conventional Similar to conventional Similar to conventional Similar to conventional	
Longevity	Slightly lower value because it is costlier to raise slaughter animals, i.e. higher marginal feed costs	Similar to conventional
Claw health	Similar to conventional	Similar to conventional
Young stock survival	Lower value because it is costlier to raise slaughter animals	Similar to conventional

2 Genetic response – using the proposed economic weights

The index weights presented in the previous chapter do not effectively describe the genetic response that can be obtained using NTM. However, genetic correlations between NTM and the sub-indices can provide an estimate for the relative genetic response than can be achieved for the different traits in the breeding goal. Since the original NTM calculations in 2008-2012, genomic selection has been introduced in the NAV countries. This enables the use of unselected genotyped bull calves for estimating the genetic response. The advantage of using unselected genotyped bull calves to predict response is that it reflects the relative genetic progress very well since genomic selection of females will results in a similar response. Furthermore, all current selection takes place among young genotyped males and females. Also, the number of genotyped bull calves and bull sires is much larger than the number of progeny tested bulls and bull sires used in the old progeny testing scheme. This minimizes the risk of one “special” bull sire affecting the range of correlations. The old method of using correlations calculated from progeny tested bulls illustrated the response well in the bull path of a breeding plan with progeny testing as the key element. However, the response in the bull dam path was not considered.

Correlations between NTM and the sub-indices were calculated using the proposed conv. NTM and org. NTM index weights. Correlations based on the original 2008-2012 NTM were also calculated for comparison. Genotyped bulls born in either DNK, SWE or FIN (Nordic bulls) in 2015 and 2016 were used for the calculations. The correlations are presented in Table 2.1, 2.2, and 2.3 for HOL, RDC, and JER, respectively. A correlation of 0.63 between proposed conv. NTM and yield index indicates that by selecting based on the conv. NTM, the genetic progress in yield will be 63% of the maximum genetic response achievable by selecting only for yield in the breeding goal.

Table 2.1. Correlations between sub-indices and original 2008-2012 NTM, conv. NTM, and org. NTM, respectively for HOL. Correlations are based on 5,218 genotyped Nordic HOL bull calves born 2015-2016.

Trait	Original 2008-2012 NTM	Proposed conv. NTM	Proposed org. NTM
Yield index	0.48	0.63	0.41
Growth	0.07	0.11	0.08
Fertility	0.48	0.44	0.53
Birth, direct	0.30	0.26	0.28
Calving, maternal	0.38	0.32	0.33
Udder health	0.47	0.34	0.58
General health	0.39	0.34	0.45
Body conformation	-0.03	0.01	-0.07
Feet and legs conformation	0.24	0.17	0.19
Udder conformation	0.23	0.11	0.21
Milkability	0.03	0.04	-0.03
Temperament	0.08	0.09	0.04
Longevity	0.60	0.50	0.61
Claw health	0.24	0.24	0.30
Young stock survival	0.29	0.23	0.27

Table 2.2. Correlations between sub-indices and original 2008-2012 NTM, conv. NTM, and org. NTM, respectively for RDC. Correlations are based on 4,368 genotyped Nordic RDC bull calves born 2015-2016.

Trait	Original 2008-2012 NTM	Proposed conv. NTM	Proposed organic NTM
Yield index	0.68	0.80	0.62
Growth	0.01	0.05	-0.02
Fertility	0.22	0.21	0.30
Birth, direct	0.23	0.14	0.19
Calving, maternal	0.19	0.16	0.20
Udder health	0.33	0.15	0.40
General health	0.22	0.17	0.28
Body conformation	0.00	0.02	-0.02
Feet and legs conformation	0.26	0.20	0.24
Udder conformation	0.16	0.04	0.14
Milkability	0.11	0.18	0.15
Temperament	0.04	0.09	0.05
Longevity	0.49	0.45	0.52
Claw health	0.15	0.14	0.20
Young stock survival	0.36	0.25	0.29

Table 2.3. Correlations between sub-indices and original 2008-2012 NTM, conv. NTM, and org. NTM, respectively for JER. Correlations are based on 862 genotyped Nordic JER bull calves born 2015-2016.

Trait	Original 2008-2012 NTM	Proposed conv. NTM	Proposed organic NTM
Yield index	0.67	0.77	0.49
Growth	0.01	0.07	0.03
Fertility	0.23	0.25	0.31
Birth, direct	0.11	0.08	0.04
Calving, maternal	0.22	0.18	0.11
Udder health	0.53	0.38	0.70
General health	0.28	0.27	0.34
Body conformation	0.15	0.15	0.09
Feet and legs conformation	0.12	0.17	0.23
Udder conformation	0.27	0.15	0.37
Milkability	0.06	0.07	0.04
Temperament	0.02	-0.01	-0.04
Longevity	0.52	0.48	0.52
Claw health[1]	0.16	0.09	0.19
Young stock survival[1]	0.33	0.28	0.27

[1]Based on progeny tested Nordic JER bulls born 2009-2010. N = 97

Table 2.4 presents correlations for NTM conv. udder and current NTM index to facilitate a fair comparison with the currently used NTM index especially because of the increased relative weight for udder conformation given to the current NTM compared with original 2008-2012 NTM.

Table 2.4. Correlations between sub-indices and conv. NTM udder and current NTM, respectively for HOL, RDC and JER. Based on genotyped Nordic bull calves as described in Table 2.1, 2.2, and 2.3 for HOL, RDC and JER, respectively.

	HOL		RDC		JER	
	Current NTM	Conv. NTM ud-der	Current NTM	Conv. NTM ud-der	Current NTM	Conv. NTM ud-der
Yield	0.41	0.54	0.65	0.74	0.59	0.68
Growth	0.03	0.12	-0.10	0.08	-0.05	0.04
Fertility	0.49	0.44	0.16	0.14	0.20	0.23
Birth, direct	0.27	0.19	0.18	0.05	0.10	0.09
Calving, maternal	0.38	0.32	0.19	0.17	0.22	0.21
Udder health	0.51	0.42	0.35	0.24	0.59	0.46
General health	0.36	0.30	0.17	0.13	0.28	0.28
Body conformation	0.00	0.08	0.04	0.13	0.19	0.20
Feet and legs conformation	0.29	0.18	0.28	0.17	0.11	0.15
Udder conformation	0.42	0.42	0.37	0.37	0.43	0.36
Milkability	0.05	0.07	0.19	0.19	0.07	0.06
Temperament	0.09	0.11	0.05	0.08	0.02	0.00
Longevity	0.63	0.55	0.45	0.41	0.48	0.49
Claw health	0.27	0.20	0.16	0.08	-	-
Young stock survival	0.27	0.19	0.32	0.21	-	-

Correlations in table 2.4 show that the genetic response by selecting after the conv NTM udder compared to current NTM will result in a bit larger progress in yield and slighter lower response in health traits. The correlation between current NTM and conv NTM udder are 0.97 for HOL, 0.95 for RDC and 0.98 for JER

For each genotyped bull used in the analyses, both a conv. NTM and org. NTM value was calculated using the respective relative weights. This enabled calculation of correlations between the two NTM indices. The correlations between conv. NTM and org. NTM were 0.95 for HOL, 0.96 for RDC and 0.91 for JER. The reason for the lower correlation for JER can partly be explained by the lower profit for beef production in organic JER compared to RDC and HOL. JER requires relatively more feed per produced slaughter animal because of slower growth rate. This affects some traits other than growth, i.e. fertility, calving traits, longevity, and young stock survival. Improvement of these traits all result in more slaughter animals. With less profit per slaughter animals this will affect organic JER more compared to RDC and HOL. This can be further investigated by running a scenario for JER where purebred JER bulls are killed at birth, reducing potential losses from purebred slaughter animals.

The correlations are relatively high but some re-ranking of animals can be expected. This may indicate that it will not be efficient to establish two separate breeding lines. In 2018 approx. 15% of the Nordic dairy cows are producing organic milk. Based on inputs from participants at the NAV workshop 2017 the expectation is that the number of organic cows will be more than doubled in the future.

Milk prices has been fluctuating a lot during the last decade and we can expect this to continue in the future also. In cases where income traits fluctuate a lot and cost traits are more stable, it will be more efficient to add extra value to cost traits in the NTM index to account for uncertainty of income traits.