Reporting from WP 2 - breeding
Klimavenlig kalve og oksekød

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Frame for WP2 - Breeding

- Calculated the effect of breeding on methane production over 10 years.

- There are only calculated on intensive production.
- For calculation of extensive production, a total new X-Indeks needed to be calculated (growing period over 550 days).

1. Determining the economic values for:
    a) Eating quality
    b) Feed efficiency
    c) Methane production

2. Calculation of the weight in X-Indekset with three different values for climate tax
    a) 120 d.kr pr tons
    b) 300 d.kr pr tons
    c) 750 d.kr pr tons

3. Effect calculation of the new X-Indeks with the economy weight of the three new indexes included.

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Economy value: Feed efficiency

- Starting point – normal economy calculation with all prices
- Three basic feeding principles
  - Phase feed with bought concentrate
  - Phase feed with a mix of home grown grain and a bought protein mix
  - TMR, typical with corn silages, grain and protein
- Slaughter time
  - Calf concept 9-10 months, 75% of the calves
  - Young bulls around12 months, 25% of the calves
- Large different in prices between bought and home grown feed
- Large uncertainty in price calculations
- **Instead a reference population is used – DLBR Slagtekalve benchmarking 2023**

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The economy value: Feed efficiency

- 54 herds with slaughter calves
- Across the groups is assumed a average pirce on 2.50 d.kr. / FE
  - Calculated a group with 80-100% cross breeding calves for efficiency
- The payment model en DMS has an average price for 2023 on 2.36 d.kr / FE

- The price is expected to be between the two and is set at 2.45 d.kr / FE

- From slagtekalve benchmarking 2023 a total use of 1413 FE / kalv is calculated
- This give a total feed cost on 3,462 d.kr / calf

- 1% improvment in feed effciency has a value on 35 d.kr / calf

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Economy value: Methane production

- Tax in 2030 on 120 d.kr pr tons CO_2e, and in 2035 on 300 d.kr pr tons CO_2e
- Basic deduction on 60 % => 40 % that tax is paid of
- If tax is paid on the 40 %, the 120 d.kr give 300 d.kr pr tons CO_2e and the 300 d.kr give 750 d.kr pr tons CO_2e.

- The four tax values in the calculations: 0 d.kr, 120 d.kr, 300 d.kr og 750 d.kr pr tons CO_2e

- Three scenarios
  1. Breeding approve as a ”virkemiddel”
  2. Breeding reduce the basic production of methane from a slaghuter calf
  3. Breeding approve as a ”virkemiddel” plus reduce the basic methane production from a slaughter calf

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Economy value: Methane production

- Scenario 1
  - Breeding reduce in the 40% where tax is paid, so full effect
    - 300 d.kr pr tons CO_2e from 2025-2030 and 750 d.kr pr tons CO_2e from 2030 and forward
- Scenario 2
  - Breeding reduce the basic methane production pr calf, whereby the total methane emission from the farm is decreasing
  - The reduction is both from the basic deduction and the tax part. Thereby the effect is only 40%
    - 120 d.kr pr tons CO_2e from 2025-2030 and 300 d.kr pr tons CO_2e from 2030 and forward
- Scenario 3
  - Both effect from scenario 1 og 2, whereby the tax is equal to scenario 1
    - 300 d.kr pr tons CO_2e from 2025-2030 and 750 d.kr pr tons CO_2e from 2030 and forward
- Scenario 3 is least likely, since breeding then must be approved twice

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Economy value: Eating quality

- At some point Danish Crown will reward good eating quality = good marbling
- Young animals slaughtered under 12 months will have a low marbling score
  - Very few animals will receive a supplement for marbling
- Properly no animals under 12 months will receive supplement for marbling
- Few animals are slaughtered between 12 and 18 months and very few animals will receive supplement for marbling

- Value of eating quality is set to 0 d.kr for animals in the present X-Indeks

- If X-Indeks for slaughter animals with a long growing period is developed, eating quality will get a economy value and shall be included in the index.

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Inclusion in the X-Indeks

- The X-Indeks has a standard structure
  - X-Indeks = (Index trait 1 – 100) * economy value for trait 1 + (Index traits 2 -100) * …

Trait	Economy value in Euro
Daily gain	0,3770
Slaughter classification	0,1005
Fat score	0,0352
Still born	0,2050
Calving ease	0,1862
Youngstock survival early period	0,1869
Youngstock survival late period	0,4315
Claw health	0,0042
Lung infection late period	0,0264
Diarra late period	0,0796
Slaughter percent	0,533
Feed efficiency	?
Methane production	?
Eating quality	?

Value of feed efficiency corrected for dead calves

- NBDI is calculated based on born calves
  - There shall be adjusted for dead calves
- 5.1 % still born or euthanized in the first day
- 4.0 % dead 1-30 days
- 5.3 % dead after day 30, average is at 88 days
  - From day 31-88 is equal to 12.2 % of the feed use – round up to 15 % based on more expensive feed in the beginning of the life of the calf
  - Recalculated 4.5 % dead after day 30 that do not eat feed (5.3*0.85)
- Total dead 13.6 % of the calves, that are not affected of better feed efficiency
- Economy value pr FE 2.45 * (1-0.136) = 2.12 d.kr pr FE

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The value of feed efficiency pr index uints

- Standard calf eat 6.84 FE at day 240
- 6.84 FE / 1.12 FE pr kg drymatter = 6.11 kg drymatter
- 6.11 kg drymatter / 0.875 percent drymatter in the feed = 6.98 kg feed
- Genetic variation 22 kg = 0.275 kg pr day (from day 200 to day 280)
- Reduction pr day in percent 0.275 / 6.98 * 100 = 3.94 %
- Total feed intake from day 29 to day 300 is 1413 FE
- Total reduction in lifetime 55.7 FE
- Genetic variation = 10 index units
- Reduction pr index units 5.57 FE
- Economy value 5.57 FE * 2.12 d.kr / FE = 11.81 d.kr
- The weight in X Indeks is in Euro 11.81 / 7.50 = 1.575 Euro
- Feed efficiency will be 42% of the value in the X-Indeks

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Value of methane production corrected for dead calves

- NBDI is calculated based on born calves
  - There shall be adjusted for dead calves
- 5.1 % still born or euthanized in the first day
- 4.0 % dead 1-30 days
- 5.3 % dead after day 30, average is at 88 days
  - From day 31-88 is equal to 12.2 % of the feed use
  - Recalculated 4.7 % dead after day 30 that do not produce methane (5.3*0.878)
- Total dead 13.8 % of the calves, that are not affected of lower methane production
- Economy values pr tons CO_2e
  - Tax 120 d.kr = 120 d.kr * 0.862 = 103.44 d.kr
  - Tax 300 d.kr = 300 d.kr * 0.862 = 258.60 d.kr
  - Tax 750 d.kr = 750 d.kr * 0.862 = 647.50 d.kr

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Value for methane production pr index uints

- FBC do not give the total methane production over a lifetime for a calf
- Investigation on Holstein calves show 16.8 – 18.9 g methane produced pr kg drymatter intake.
- It give 24.5 – 27.2 kg methane in the lifetime for a slaughter calf
- With 25 kg methane and 200 kg slaughter weight, a kg slaughter body equal to 125 g methane
- Slaughter weight for crossbreeding calves is 213 kg = 26.6 kg methane pr claf
- Factor 25.5 for CO_2e to methane = 0.678 tons CO_2e
- Genetic variation 0.019 kg methane pr day (from day 200 to day 280)
- Assume the methane production is the same pr FE
- Production pr FE = 26.6 kg methane / 1413 FE = 0.0188 kg methane pr FE
- Basic calf consume 6.84 FE at day 240 equal to 0.129 kg methane
- Reduction in methane production 0.019 / 0.129 * 100 = 14.8 %

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Value of methane production pr indeks unit

- Total reduction in methane = 26.6 kg methane *0.148 = 3.94 kg methane
- Total reduction in CO_2e = 3.94 kg methane * 25.5 kg CO_2e / methane
  = 100.5 kg CO_2e
- Genetic variation = 10 index units
- Reduction pr index units 10.05 kg CO_2e = 0.01005 tons CO_2e
- Economy value in Euro
  - Tax on 120 d.kr pr tons CO_2e: 0.01005 * 103.44 / 7.50 = 0.139
  - Tax on 300 d.kr pr tons CO_2e : 0.01005 * 258.60 / 7.50 = 0.347
  - Tax on 750 d.kr pr tons CO_2e : 0.01005 * 647.50 / 7.50 = 0.866

- At a tax on 750 d.kr. pr tons CO_2e the methane production will have the biggest value in the present X-indeks

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Value og eating quality pr index unit

- Since eating quality do not have an economy value for the calves in the X-indeks the value pr index unit is 0 d.kr.

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The breeding plan

- The present planned breeding program for Danish Blue cattle
- 120 purebreed females where 20 are female donors in ET
- 5 claves pr donor + 100 from normal inseminations = 200 offspring pr year
- 30 bulls are tested pr year
  - No genomic selection
- Proven when the bulls are 3 years
- 12 proven sires pr year
- Random mating
- Culling 20% of the bulls and 15% of the females pr year

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Simulation program ADAM

- 25 replications
- 20 years (use year 10-20 in the results)
- 11 traits in the model
  - 9 old and 2 new traits (feed efficiency and methane production)
- Reliability on the traits calculated according to 1200 inseminations
  - 200-225 offspring pr traits
  - 25 offspring for feed efficiency and methane production
- Inbreeding between 0.5 and 1.0 percent

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Senarios

1. CO_2 tax 0 d.kr and full weight on feed efficiency
2. CO_2 tax 120 d.kr and full weight on feed efficiency
3. CO_2 tax 300 d.kr and full weight on feed efficiency
4. CO_2 tax 750 d.kr and full weight on feed efficiency
5. CO_2 tax 0 d.kr and half weight on feed efficiency
6. CO_2 tax 120 d.kr and half weight on feed efficiency
7. CO_2 tax 300 d.kr and half weight on feed efficiency
8. CO_2 tax 750 d.kr and half weight on feed efficiency

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Results, genetic progress

Full weight on feed efficiency	Feed efficiency	Methane produc-tion	Dayli gain	Slaughter classify-cation	Slaughter percent	Fat score	Still born	Calving ease	Young stock survival early	Young stock survival late	Health
CO_2 tax 0 d.kr.	0.13	0.027	0.072	0.072	0.116	-0.036	-0.025	-0.043	-0.031	-0.026	-0.011
CO_2 tax 120 d.kr.	0.12	0.052	0.077	0.086	0.106	-0.035	-0.031	-0.041	-0.021	-0.038	-0.011
CO_2 tax 300 d.kr.	0.122	0.068	0.086	0.085	0.124	-0.044	-0.03	-0.047	-0.018	-0.026	-0.028
CO_2 tax 750 d.kr.	0.11	0.11	0.074	0.094	0.117	-0.036	-0.027	-0.047	-0.024	-0.031	-0.036

Half weight on feed efficiency	Feed efficiency	Methane produc-tion	Dayli gain	Slaughter classify-cation	Slaughter percent	Fat score	Still born	Calving ease	Young stock survival early	Young stock survival late	Health
CO_2 afgift 0 kr.	0.095	0.061	0.085	0.098	0.147	-0.029	-0.009	-0.034	-0.021	-0.006	-0.024
CO_2 afgift 120 kr.	0.093	0.078	0.086	0.093	0.136	-0.039	-0.003	-0.029	-0.008	-0.02	-0.023
CO_2 afgift 300 kr.	0.076	0.076	0.082	0.096	0.145	-0.029	-0.013	-0.036	-0.027	-0.012	-0.017
CO_2 afgift 750 kr.	0.067	0.133	0.077	0.088	0.116	-0.027	-0.012	-0.035	-0.016	-0.014	-0.042

Results feed efficiency

Only half of the gentic in the cross brreding calf comes from beef cattle

Full weight on feed efficiency	Progress	Reduction in kg feed pr year*	Reduction in kg feed over 10 years	Reduction in FE over 10 years**	Percentwise reduction over 10 years	Percentwise reduction over 10 years for cross breeding calves
CO_2 tax 0 d.kr.	0,13	9,72	97,2	95,3	**6,74**	**3,37**
CO_2 tax 120 d.kr.	0,12	8,98	89,8	88,0	**6,23**	**3,11**
CO_2 tax 300 d.kr.	0,122	9,13	91,3	89,4	**6,33**	**3,16**
CO_2 tax 750 d.kr.	0,11	8,23	82,3	80,6	**5,71**	**2,85**

Half weight on feed efficiency	Progress	Reduction in kg feed pr year*	Reduction in kg feed over 10 years	Reduction in FE over 10 years**	Percentwise reduction over 10 years	Percentwise reduction over 10 years for cross breeding calves
CO_2 tax 0 d.kr.	0,095	7,11	71,1	69,6	**4,93**	**2,46**
CO_2 tax 120 d.kr.	0,093	6,96	69,6	68,2	**4,82**	**2,41**
CO_2 tax 300 d.kr.	0,076	5,68	56,8	55,7	**3,94**	**1,97**
CO_2 tax 750 d.kr.	0,067	5,01	50,1	49,1	**3,48**	**1,74**

* Progress * variance on 74,8 equal 0,275 gram pr day

** 1.12 FE / kg drymatter and 87,5% drymatter / kg feed

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Results methane production

Only half of the gentic in the cross brreding calf comes from beef cattle

Full weight on feed efficiency	Progress	Reduction in kg CO_{2e} pr year*	Reduction in kg CO_{2e} over 10 years	Percentwise reduction over 10 years**	Percentwise reduction over 10 years for cross breeding calves
CO_2 tax 0 d.kr.	0,027	2,13	21,3	**3,14**	**1,57**
CO_2 tax 120 d.kr.	0,052	4,10	41,0	**6,04**	**3,02**
CO_2 tax 300 d.kr.	0,068	5,36	53,6	**7,90**	**3,95**
CO_2 tax 750 d.kr.	0,11	8,66	86,6	**12,78**	**6,39**

Half weight on feed efficiency	Progress	Reduction in kg CO_{2e} pr year*	Reduction in kg CO_{2e} over 10 years	Percentwise reduction over 10 years	Percentwise reduction over 10 years for cross breeding calves
CO_2 tax 0 d.kr.	0,061	4,80	48,0	**7,09**	**3,54**
CO_2 tax 120 d.kr.	0,078	6,14	61,4	**9,06**	**4,53**
CO_2 tax 300 d.kr.	0,095	7,48	74,8	**11,03**	**5,52**
CO_2 tax 750 d.kr.	0,133	10,47	104,7	**15,45**	**7,72**

* Progress * variance on 0,255 kg CO_{2e} / kg gain and 350 kg gain in lifetime

** Total CO_{2e} production is 678 kg in lifetime

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Konklusion

- Economy value for feed efficiency 2.45 d.kr pr FE
  - Weight pr index unit 1.575 Euro
- Economy value for methane production 120 d.kr, 300 d.kr and 750 d.kr / tons CO_{2e}
  - Weight pr index unit 0.139, 0.347 and 0.868 Euro
- Economy value for eating quality 0 d.kr
  - Weight pr index unit 0.000 Euro

- Progress in 10 years for feed efficiency are between 1.74 and 3.37 percent

- Progress in 10 years for methane reduction are between 1.57 and 7.72 percent

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Discussion

- The new weights in X-Indeks will give negative progress for all the functional traits

- Large assumes in the Methane model
  - Ration trait difficult to estimate methane production from
  - Methane is a new trait, and we have low amount of data and experience

- High weight on feed efficiency and methane production

- Fix breeding plan → changes in the breeding plan can have large effects

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