Incorporating genetic information about methane into the *Dutch Annual Nutrient Cycling Assessment*

ICAR THE GLOBAL STANDARD FOR LIVESTOCK DATA

C.I.V. Manzanilla-Pech, B. Gredler-Grandl, M. de Haan, H. van Laar, N. Meijer, A.E. van Breukelen, G. de Jong, and R.F. Veerkamp.

WAGENINGEN UNIVERSITY WAGENINGEN UR

CRV Coöperatie BETTER COWS > BETTER LIFE

KRINGLOOP WIJZER

Importance

- Several countries are introducing or planning to introduce a *carbon tax* on *livestock farms*
- It could be *incentivized* by a *rewarding credit system*
- It needs to be *accepted* and *adopted* by *farmers*
- *Economic* consequences?
- Help to reach *climate goals*

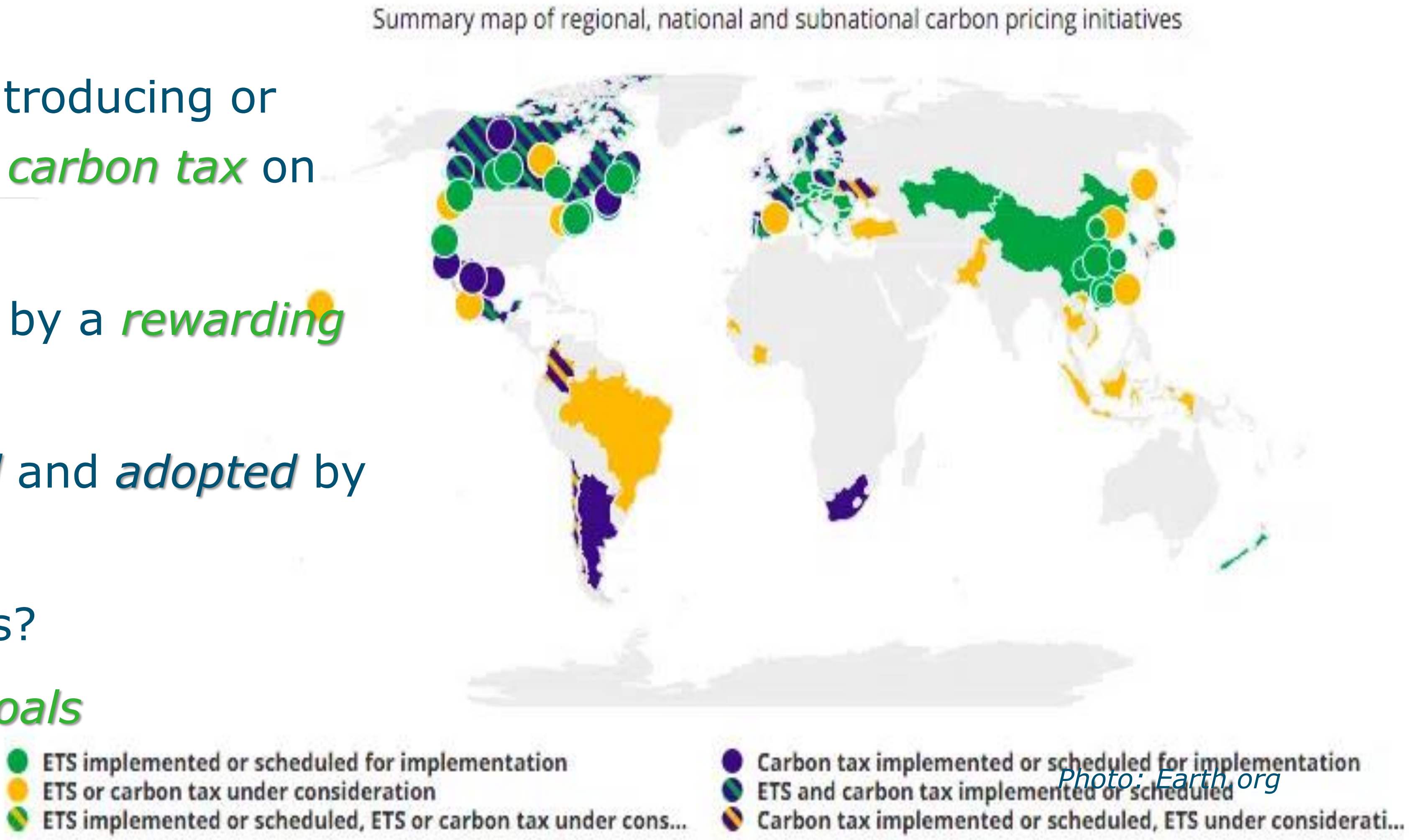


Photo: Earth.org

Annual Nutrient Cycling Assessment (ANCA)

- A *tool* that provides a *scientific* and reliable *overview* of the cycle and *N, P and C losses*.

- Uses *indicators* to calculate farm specific *environmental performances*

KRINGLOOP WIJZER

ANCA Indicators

1. Manure production
2. Efficiency of animal feeding
3. Emission of ammonia (NH_3)
4. Yields of pasture
5. Fertilisation efficiency
6. Soil surplus of N and P_2O_5
7. Nitrate (NO_3) in groundwater
8. ***Greenhouse gas emissions****: methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2) IPCC: the Tier 3 level*
9. Farm surplus N, P_2O_5 and C
10. Farm efficiency

TIER 3 Method

A dynamic ***mechanistic simulation model*** to estimate the ***emission factor (EF)*** of the different ***feeds*** (or a ***total ration***) based on the ***chemical composition and digestion*** characteristics of the specific feed ingredient.

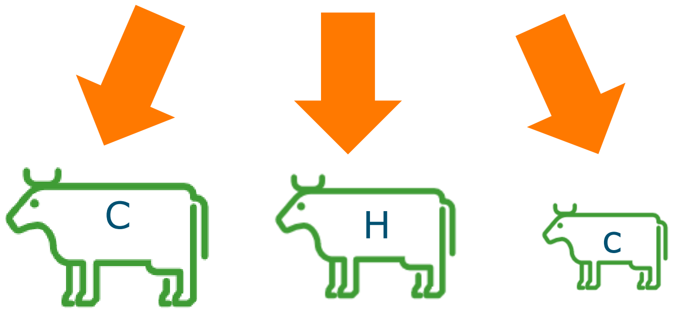
Based on **Šebek et al. (2020)**

Methane calculation

75-80% enteric CH4

Total amount of DMI from roughage

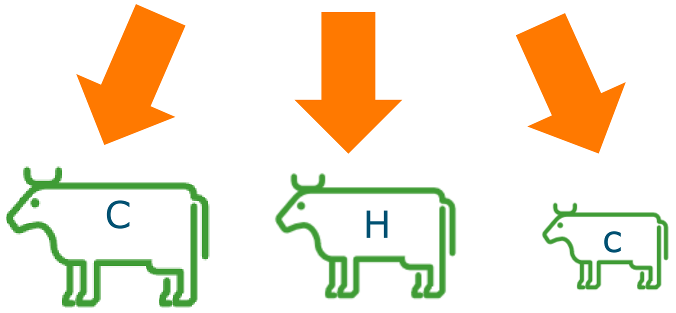
% of maize silage



How does it work

Total amount of DMI from roughage

% of maize silage



$$\text{EF\_correction (g CH4/kg DM)} = 0.21 \text{ x } (\text{DM intake per day} - 18.5)$$

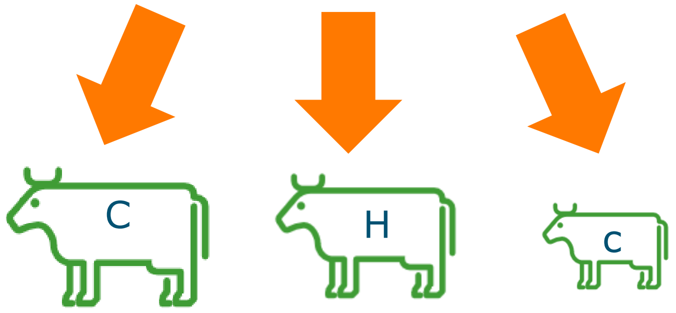
$$\text{CH4\_ration} = \text{EF\_CH4\_ration x DM intake of dairy herd}$$

How does it work

Phase 1

Total amount of DMI from roughage

% of maize silage

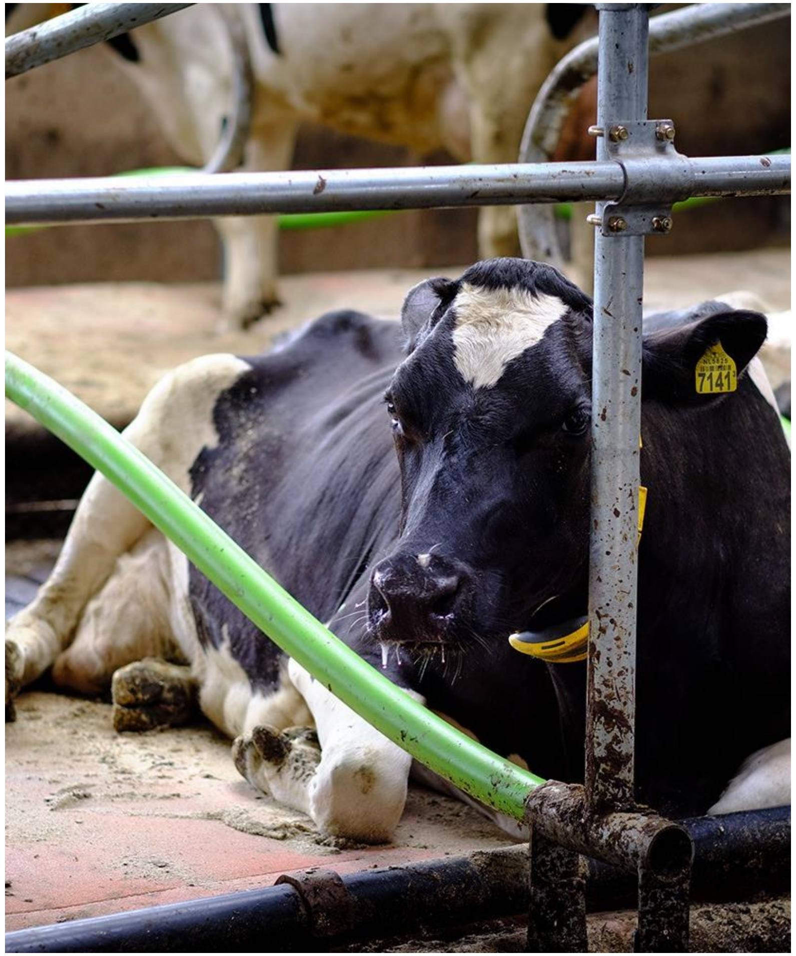


Phase 2

*CO_2 emission milk = kg CO_2 equivalents emission dairy cattle / 1000 * Allocation factor milk / Production FPCM*

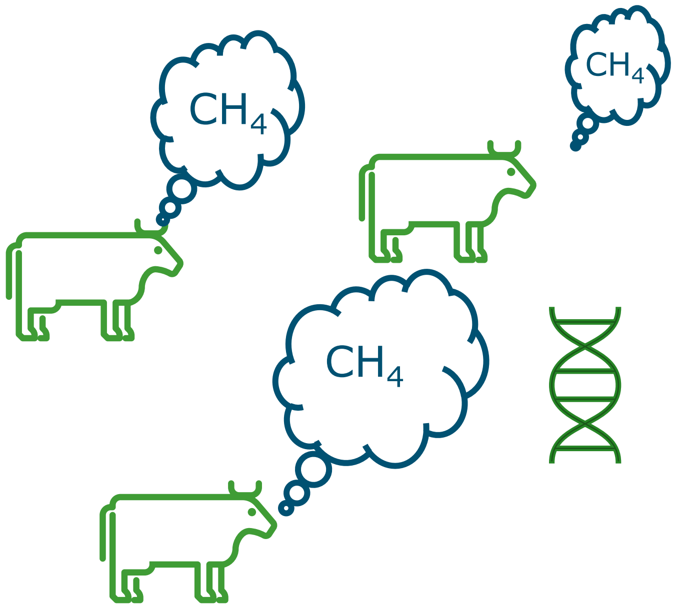
Main limitation

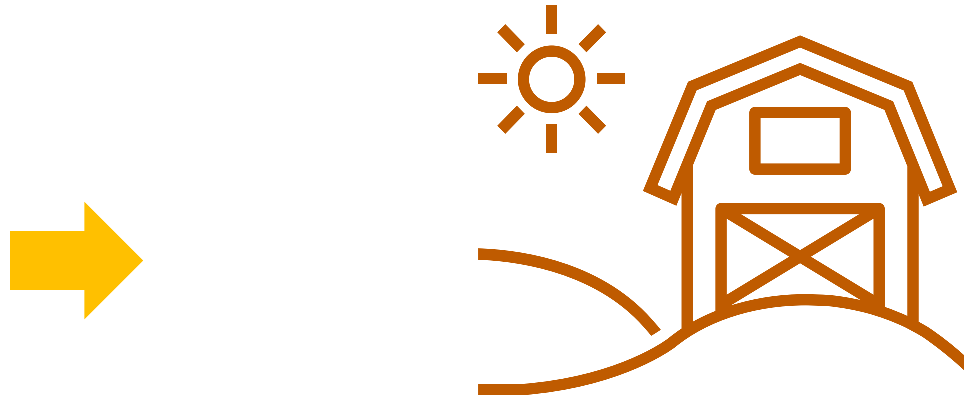
It does not consider the *genetic variations* among *cows* within a single farm, assigning the same *emission* value to *all cows* based *solely* on their *diet*.



Objective

Investigate how to incorporate *individual genetic information* into the calculation of *CH_4 emissions* for the entire dairy *herd*.





How could this work?

Genetics

- Individual level
- Daily basis
- Mainly with cows in lactation

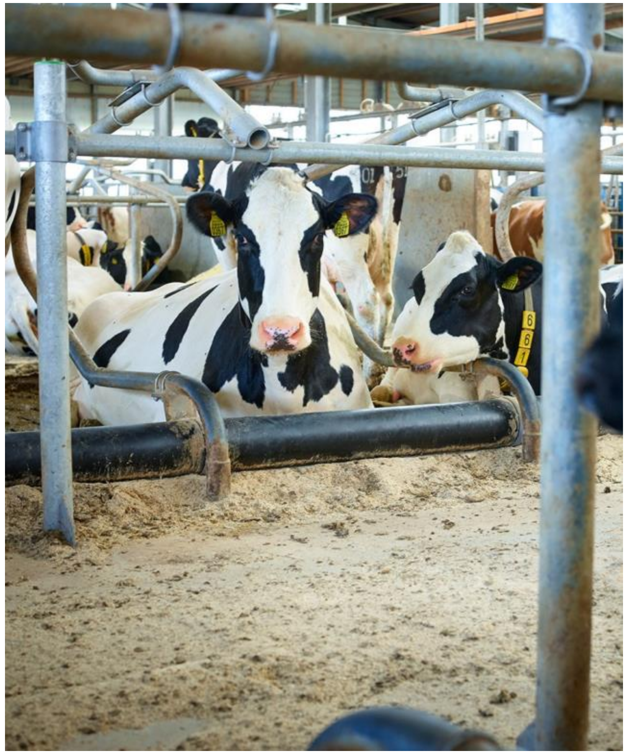
≠

ANCA

- Herd level
- Yearly basis
- All animals in the farm

Initial proposal

- Incorporating data on the average CH_4 (g/d) EBV of the farm's cows to identify potential differences among farms.



Example

CH_4 ppm

- 180k records
- 8,858 cows
- 72 commercial farms
- 1-4+ parities
- 405 DIM
- 2019-2023

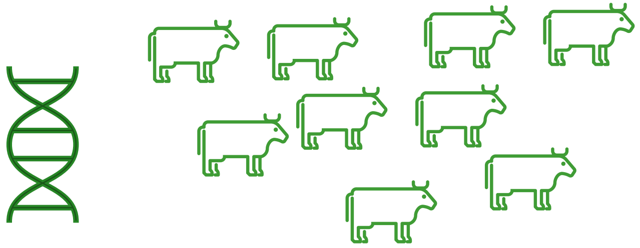
CH_4 g/d

- 150k records
- 6,823 cows
- 59 commercial farms
- 1-4+ parities
- 405 DIM
- 2021-2023

Methodology

$$y = Fixed\ Effects + a + pe + e$$

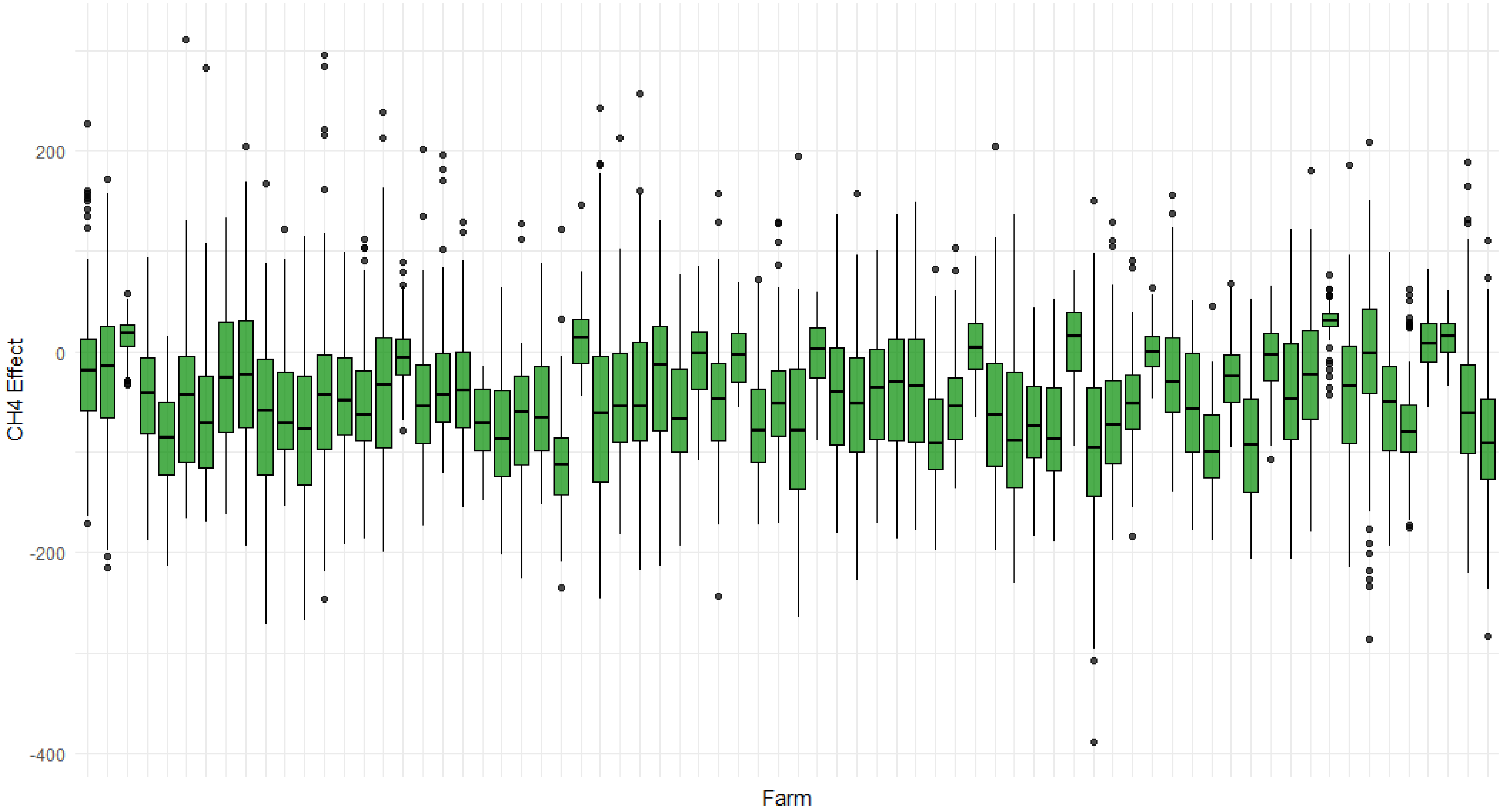
$$Herd + year * season + Lact_{week} + parity$$



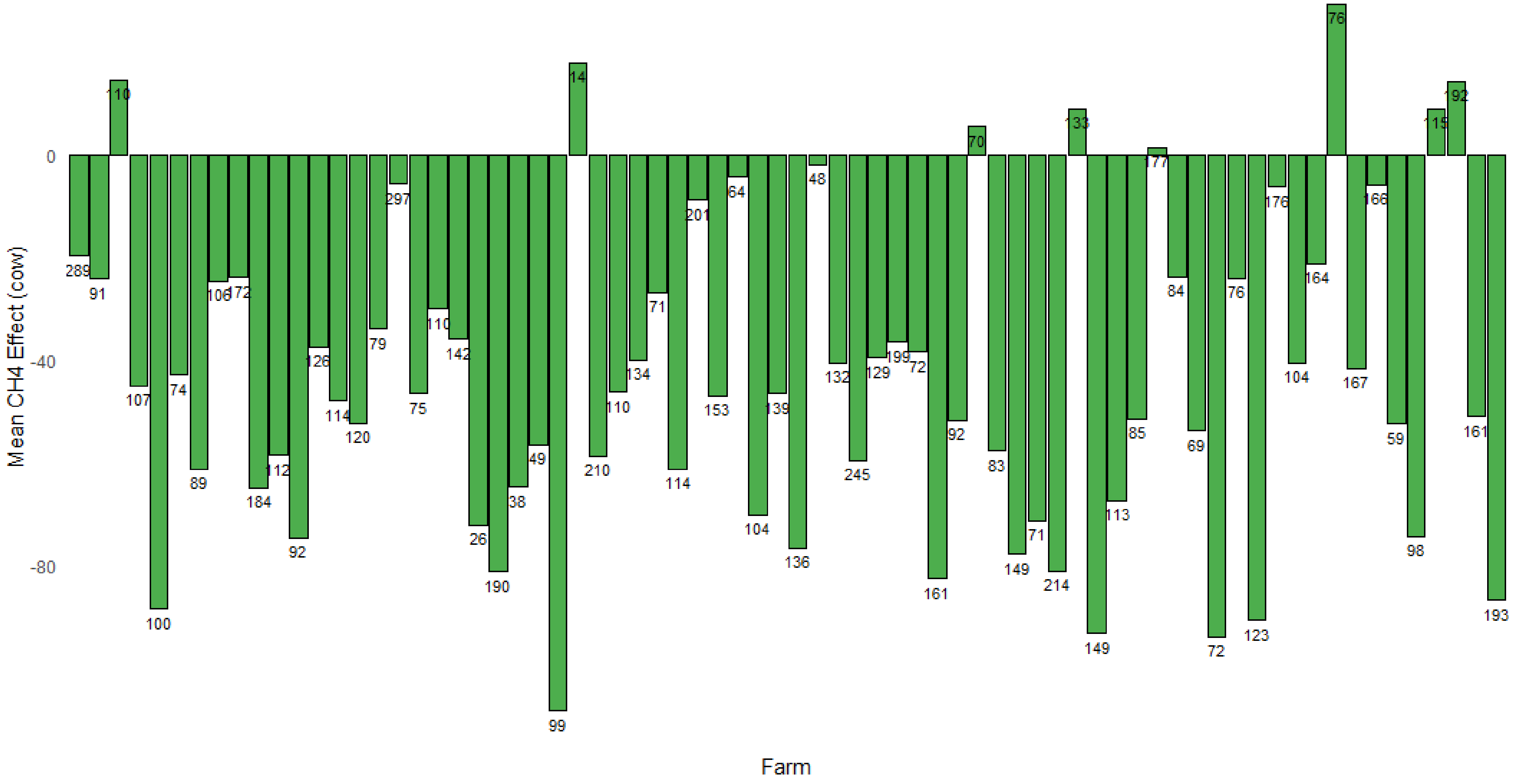
CH_4

Average EBV per farm

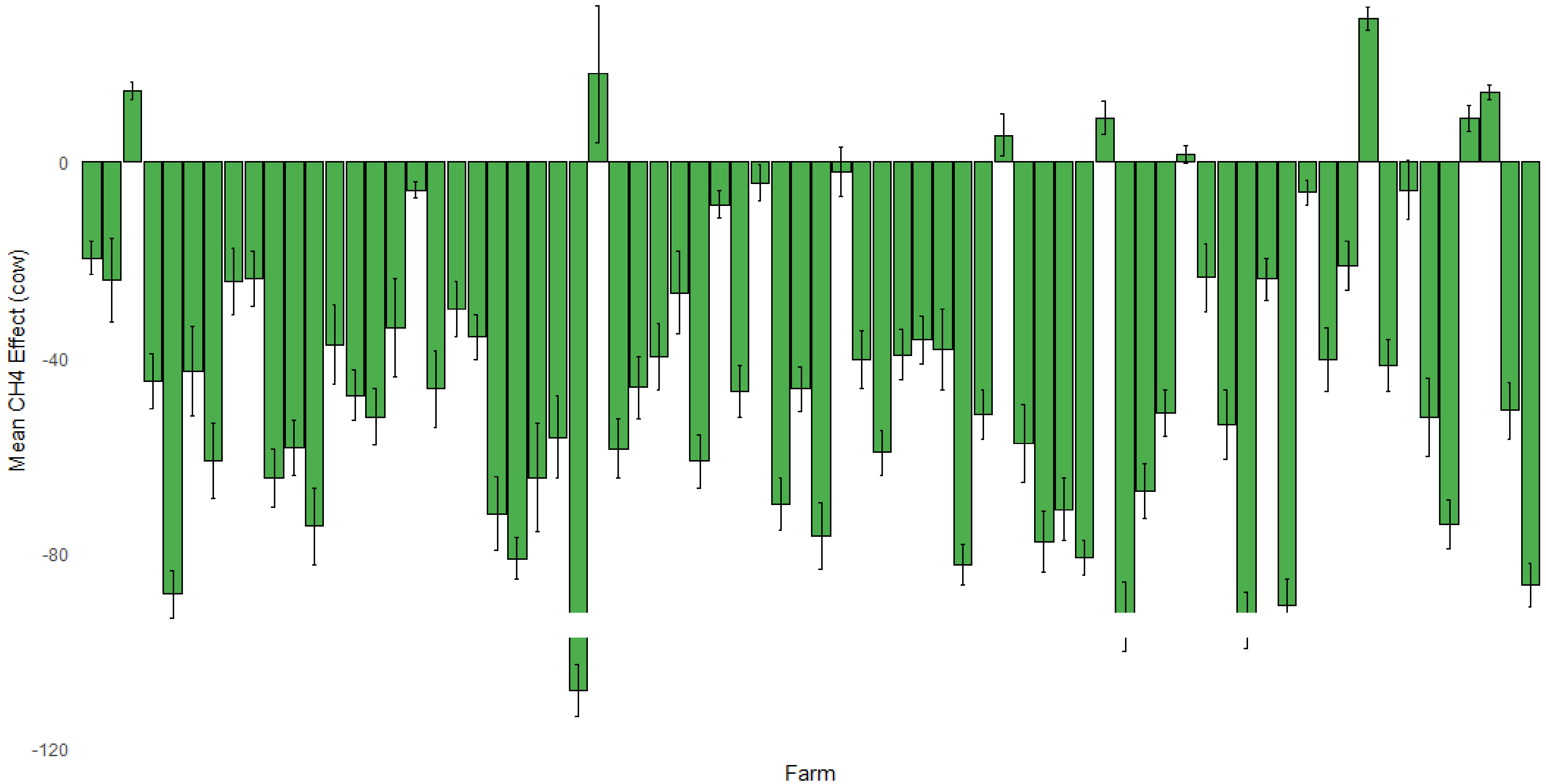
Genetic differences per farm (*cow level*)



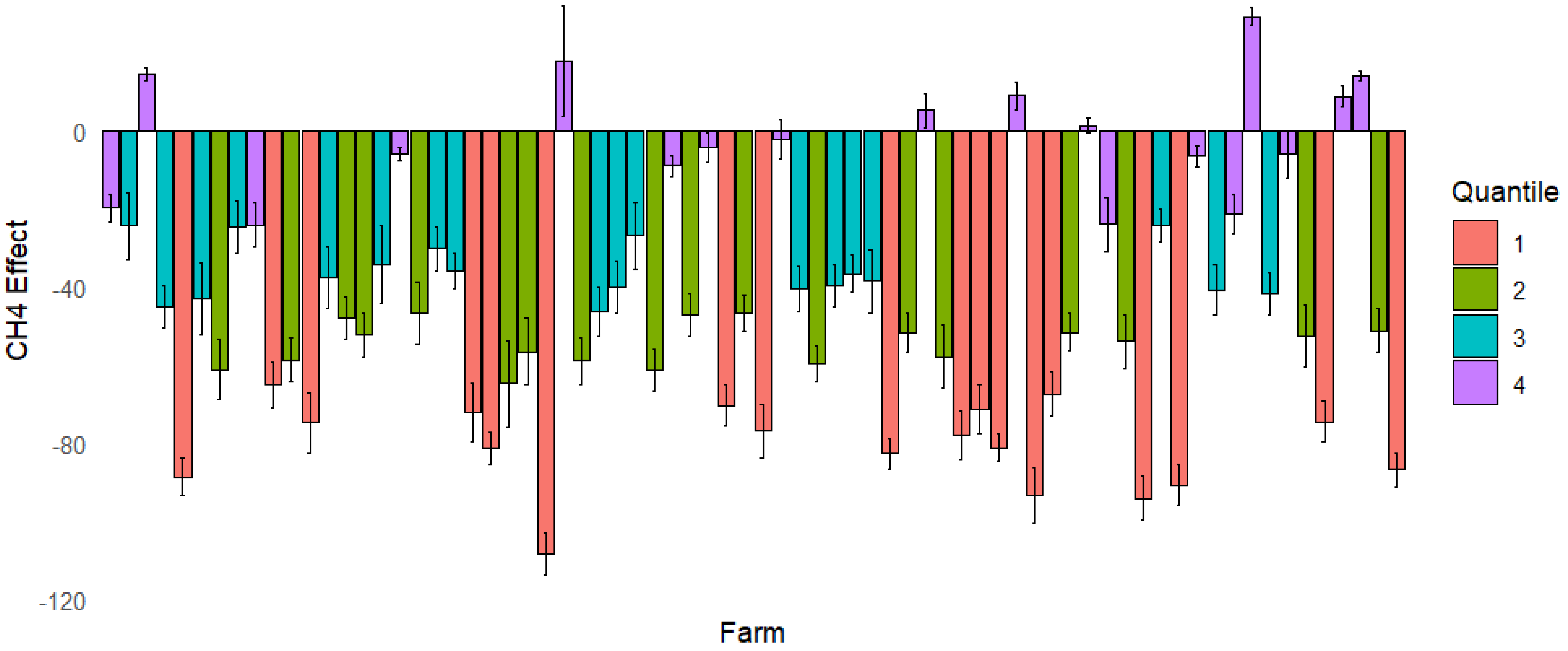
Genetic differences per farm (*cow level*)



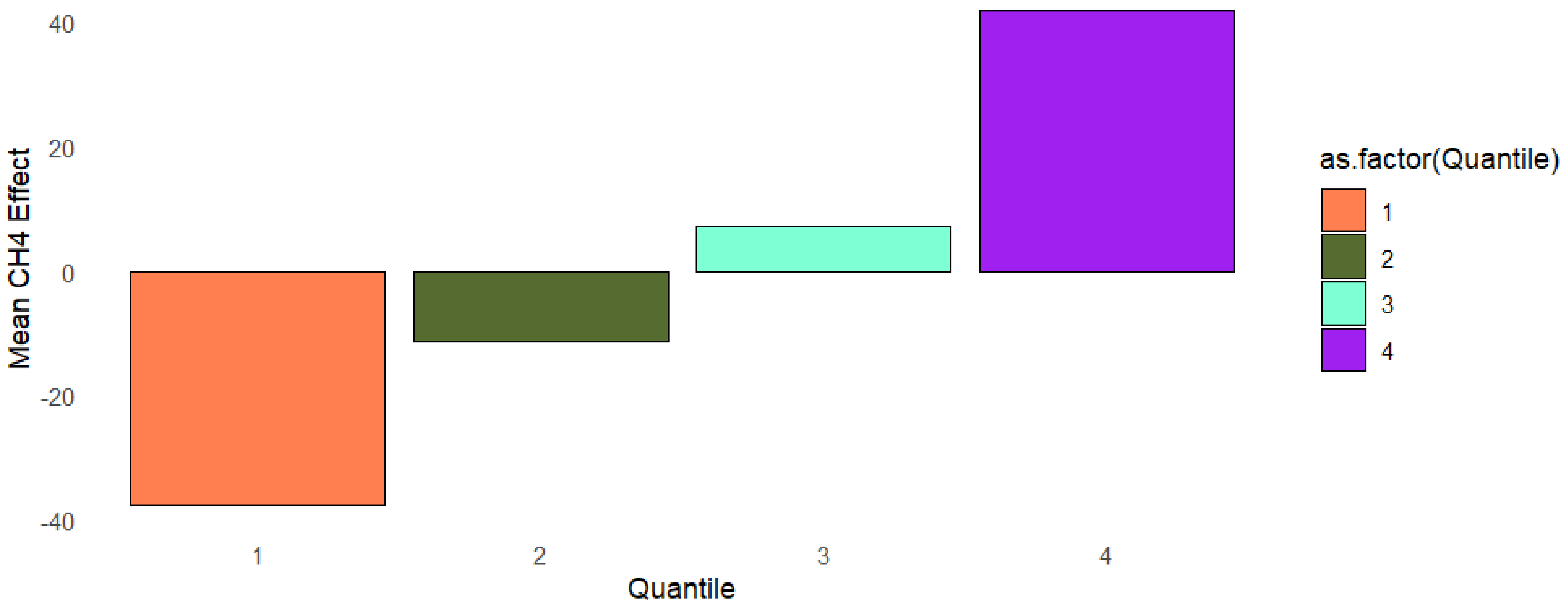
Genetic differences per farm (*cow level*)



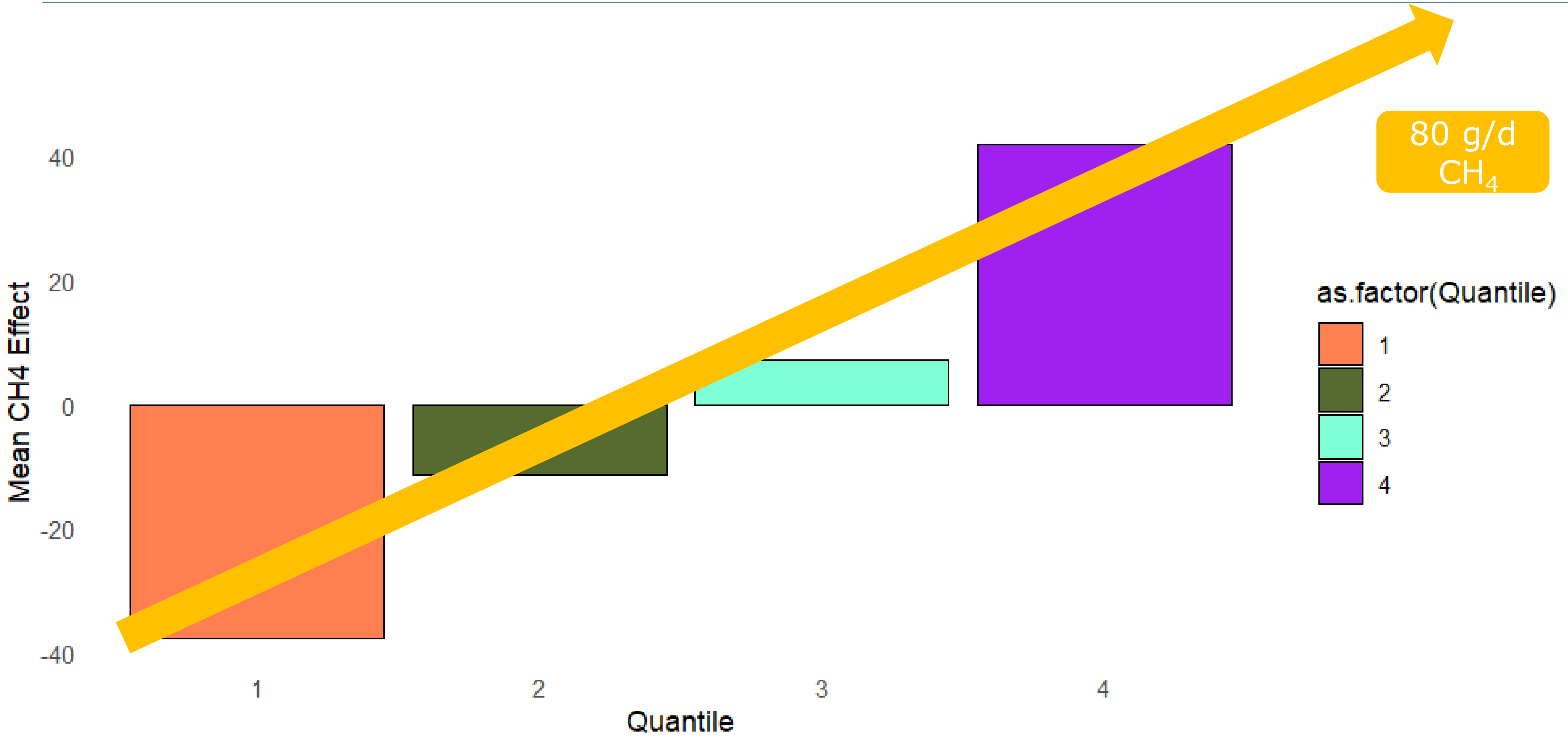
Quantile differences per farm



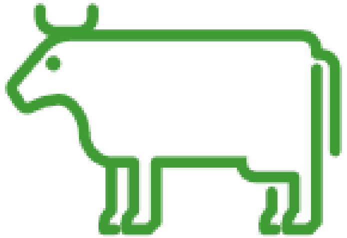
Quantile differences per farm



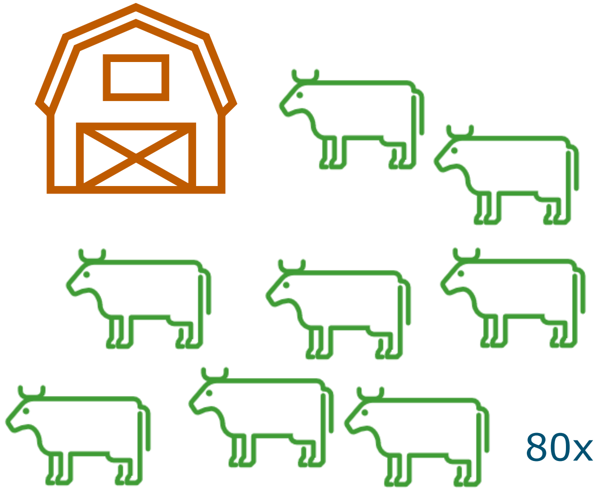
Quantile differences per farm



Quick calculation



80 g/d CH_4



80x

6.4 kg/d CH_4

365 days

2.33 ton CH_4

Quick calculation

80x

365 days

80 g/d CH_4

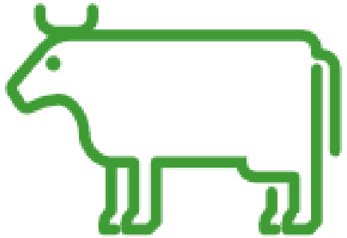
6.4 kg/d CH_4

2.33 ton CH_4

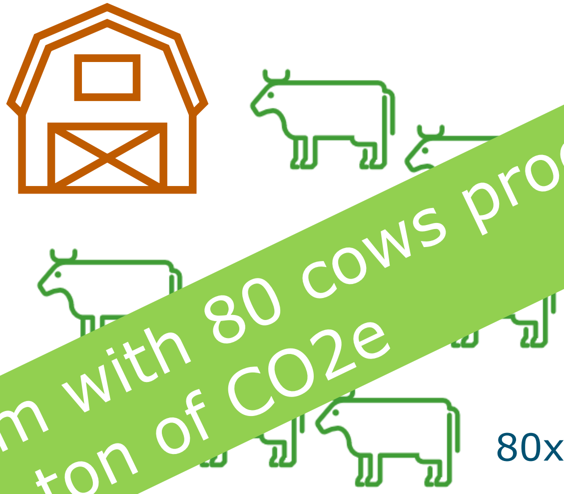
79.4 ton CO_2 e

WAGENINGEN UNIVERSITY
WAGENINGEN UR

Quick calculation



80 g/d CH



80x

6.4 kg/d CH_4

365 days

2.33 ton CH_4

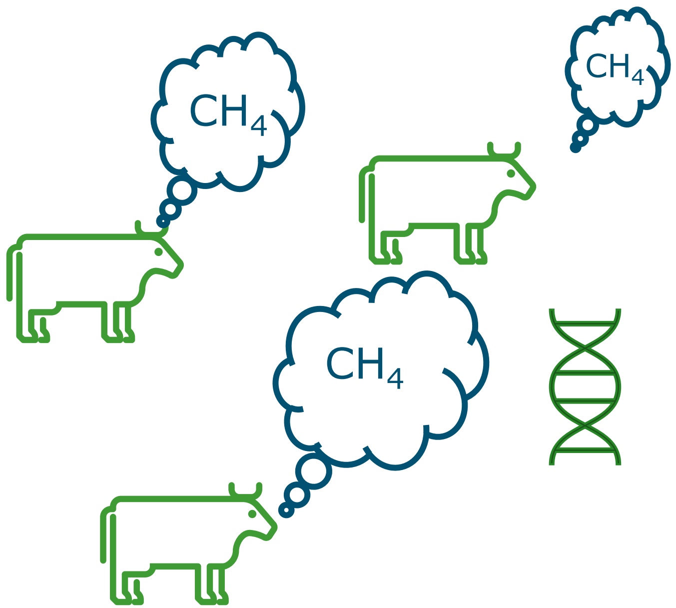
79.4 ton CO_2 e

One research farm with 80 cows produces 366 ton of CO2e

20% diference

Take home message

It is *feasible* to include *individual genetic information* to account for the total CH4 production at *farm level*



Thank you for your attention

Thank you for your attention

Let’s open the conversation!