Breeding goals based on farm type and agro-ecology in crossbred dairy cattle in Ethiopia

Based on data from Sidama & Oromia regions

Mirjam Spoelstra, Gemeda Duguma, Abule Ebro, Jan ten Napel, Aniek Bouwman

04/09/2024 - EAAP Conference Florence

WAGENINGEN UNIVERSITY & RESEARCH

Embassy of the Kingdom of the Netherlands

SNV Ethiopia

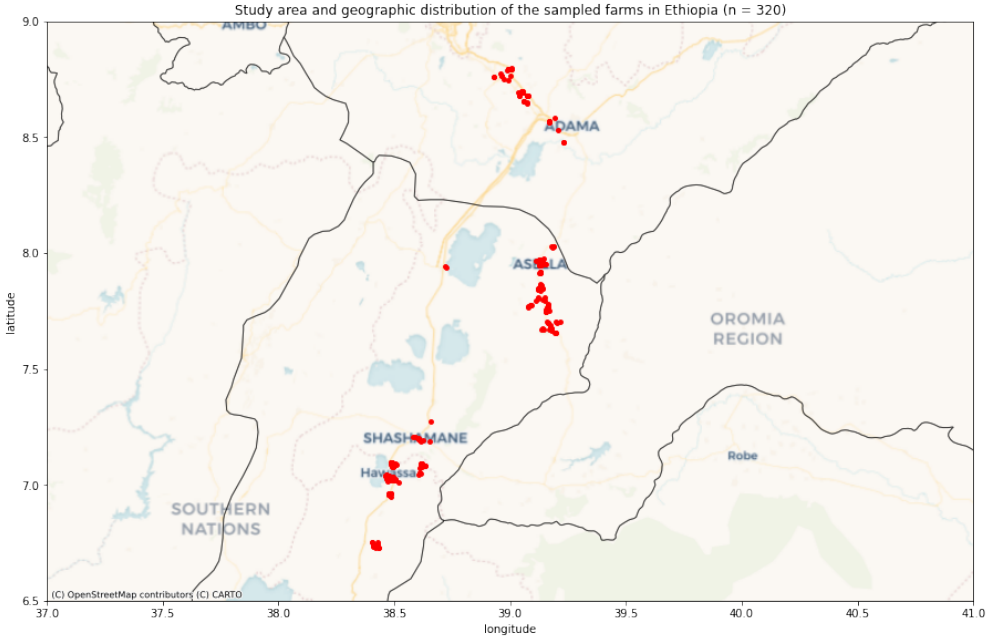
LDI Ethiopia

Dairy breeding programmes in Ethiopia

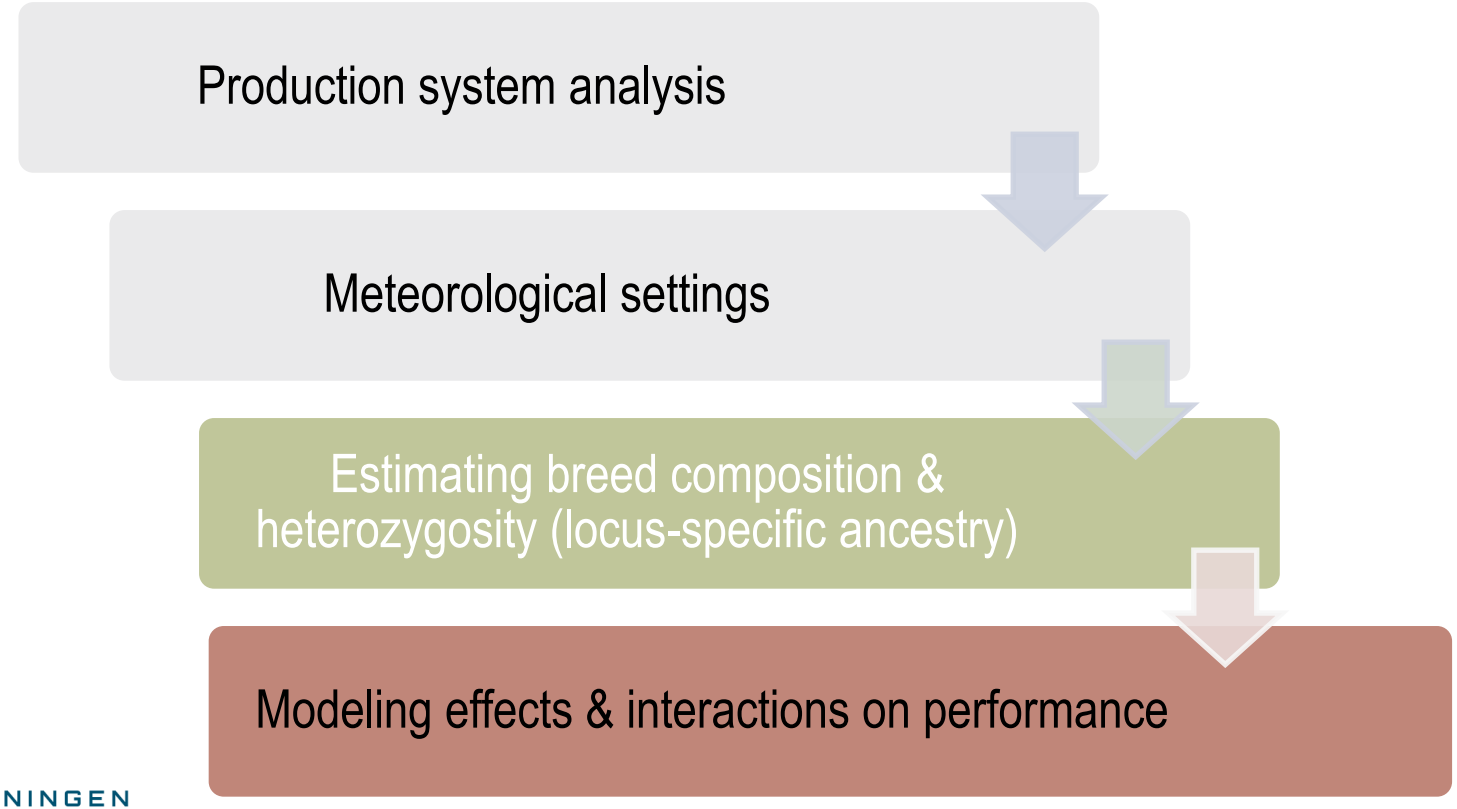
- Emphasis on increasing genetic potential through the introduction of temperate high-yielding breeds
- However high variance in performance of crossbreeds
- Limited research that accounts for breed levels, agro-ecology and farm settings
- **Main objective:** Define the optimal genotypes for the different agro-ecologies and farm production systems in Oromia and Sidama Regions, Ethiopia.

Data

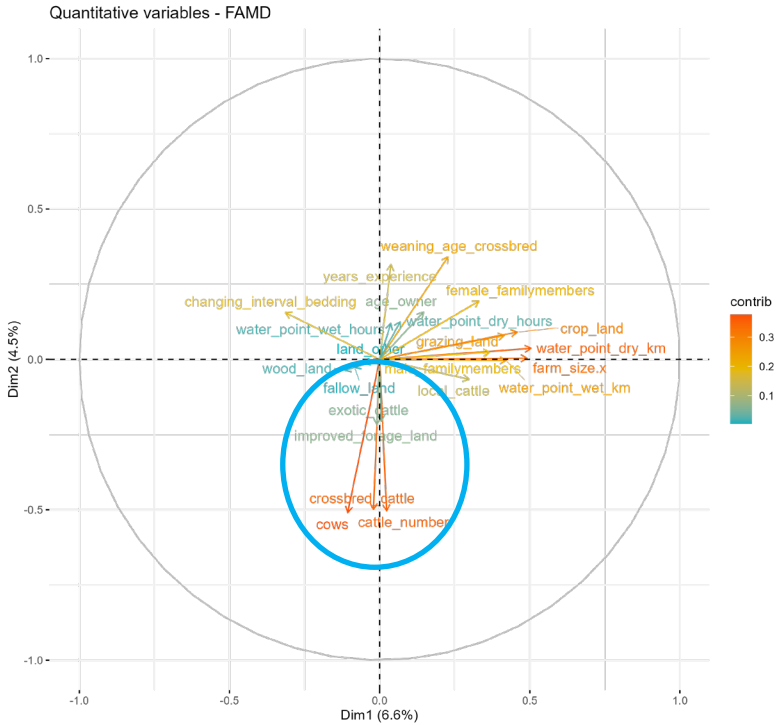
1. **Performance data**
   - Milk yield, fertility, calf weight
   - Weekly records for 9 months (2022-2023)
   - 320 farms; 3159 animals
2. **Genotypes (100K)**
   - 295 farms; 848 animals
3. **Meteorological data**
   - 220 farms; 7 variables
4. **Production system data**
   - 293 farms:
   - 262 qualitative variables &
   - 25 quantitative variables



Methodology

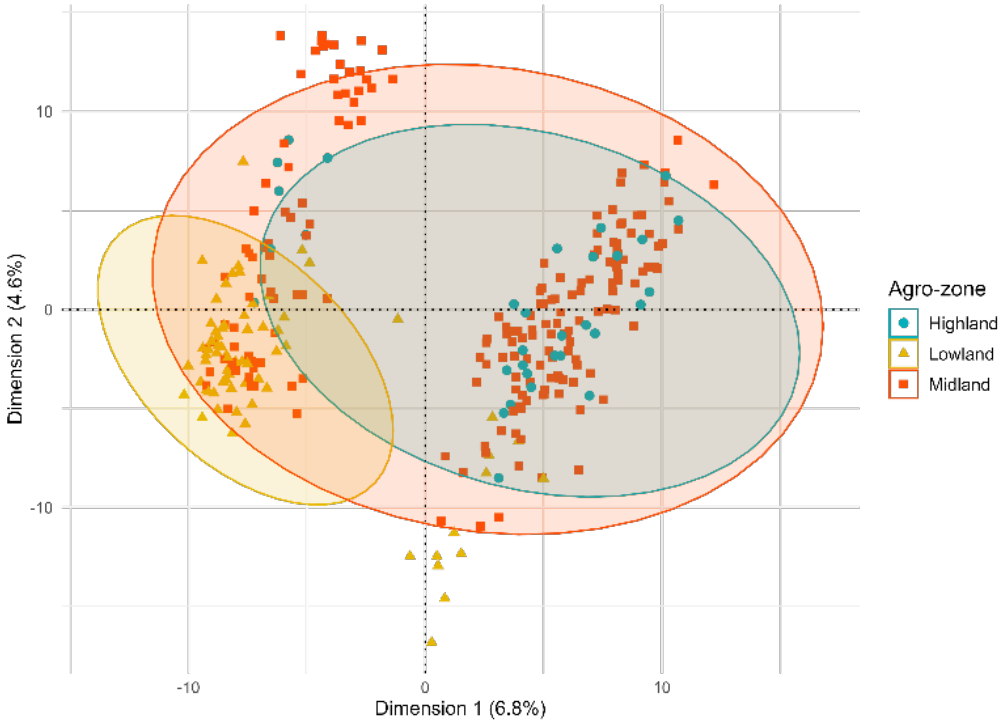


Production system analysis



- Factor analysis of mixed data (FAMD): explore association between variables
- Quantitative variables (n=25)
- Qualitative variables (n=262)
- Helps us to identify variables associated with the differences between e.g. different agro-ecological zones, farm sizes and settlement types

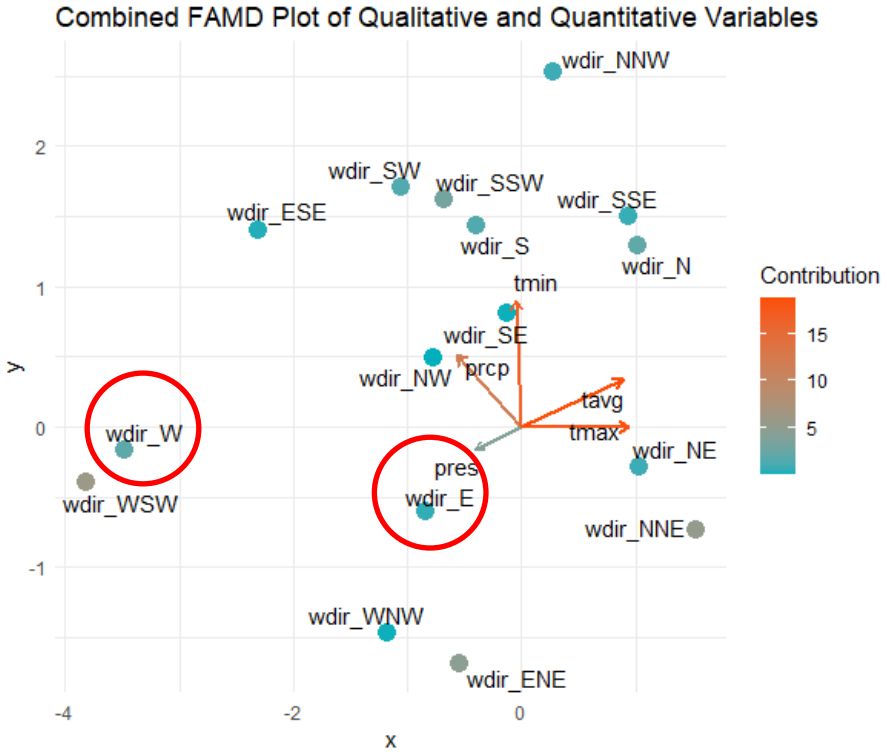
Differences between agro-ecological zones



- Differences between lowland and highland ($p<0.05$):
- Lowlands: large urban farms, rented land, labor, water availability in all seasons.
- Highlands: little feed conservation, water provided by rivers, family labor, much availability and use of grazing lands.

WAGENINGEN
UNIVERSITY & RESEARCH

Meteorological settings



FAMD shows seasonal patterns related to the wind directions:

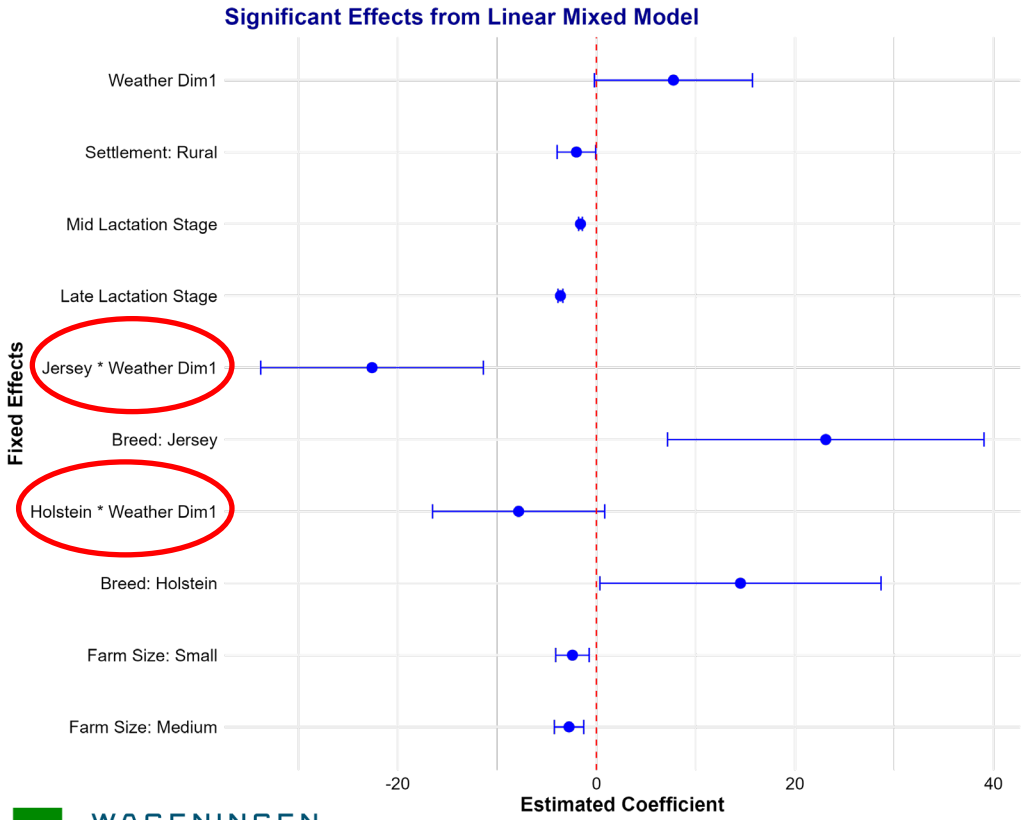
- Guinea monsoon winds from the west: precipitation, cloud coverage, low temperatures.
- Easterlies from the Indian ocean: bringing cool air and depending on the season small rains.
- Instead of THI, incorporate first two dimensions of FAMD in model for milk yield

Mixed linear model

Mixed linear models were run using different datasets for performance (test-day milk yield, fertility, calf weight) –e.g. for test-day milk yield with meteorological data:

1. $$y_{ijklmnopqrs} = \mu + \beta_1 Holstein_i + \beta_2 Arsi_j + \beta_3 Borana_k + \beta_4 Heterozygosity_l + lactation\ stage_m + Parity_n + farm - size_o + Agro - zone_p + Dim1 - weather_q + Dim2 - weather_r + Enumerator_s + Farm_t + Cow_u + e_{ijklmnopqrstuv}$$

Milk yield: breed x weather

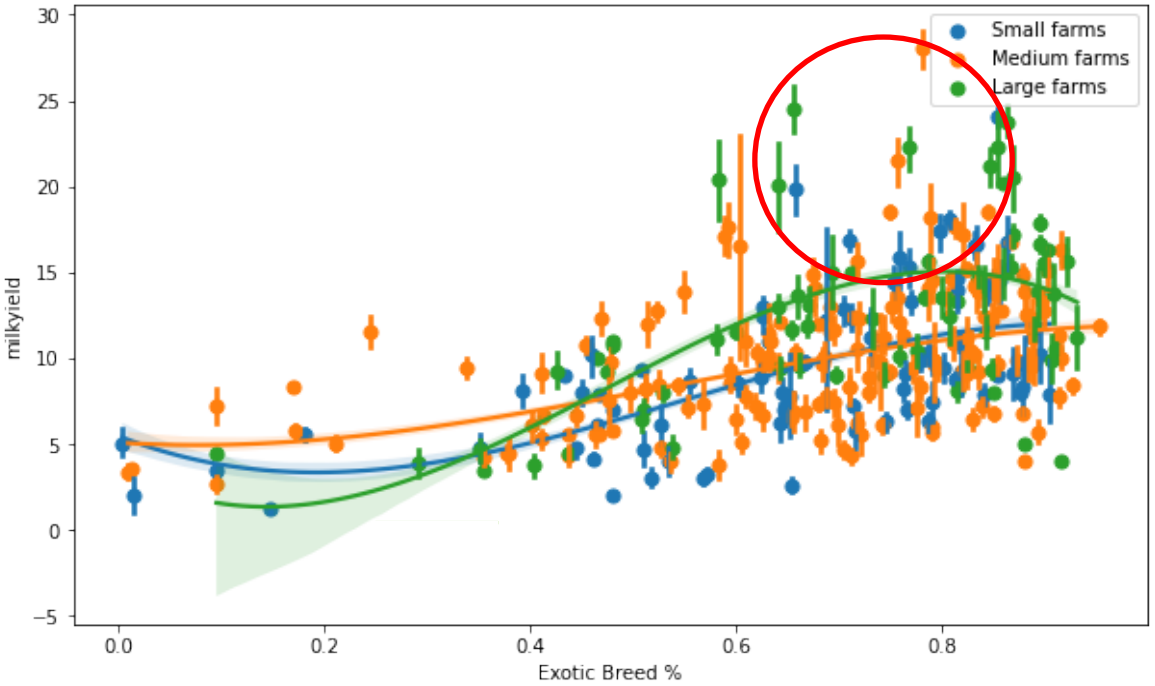


Test day milk yield (p<0.1):

- Base level = Arsi
- Weather Dim1:
  - low value: rainy season and/or cooler temperatures
  - high value: warmer temperatures and/or dry season
- Depicts clear difference in compatibility with climate between temperate breeds (Holstein/Jersey) and local breeds (Arsi/Borana)

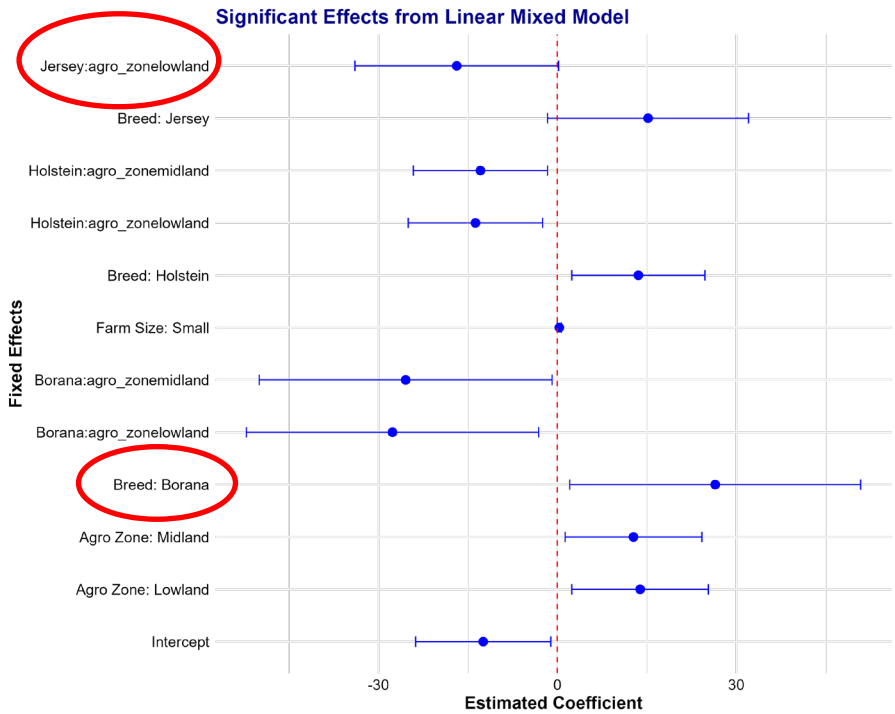
WAGENINGEN
UNIVERSITY & RESEARCH

Influence of breed composition on milk yield



- Large variation regardless of farm size
- Optimum around 60-90 exotic breed%
- No significant effects found for heterozygosity

NSC: Interactions breed x agro-ecological zone



Number of services per conception (NSC) (p<0.1):

- Base level = Arsi & Highlands
- NSC lowest in lowlands for Jersey
- Increased NSC in highlands for Holstein, Jersey & Borana
- Arsi lowest NSC in highlands

Conclusion

- Results suggest that Arsi-Bale breed is better suited to the highlands whereas Holstein/Jersey/Borana crossbreeds have better performance in Lowlands/Midlands.
- Hot dry weather negatively affects temperate breeds
- Crossbreeds with 60-90% exotic breed level most promising for milk yield

- Next step: Consider farm&animal profitability

Take-home message

- Breeds and breeding programmes in Ethiopia should be adapted to their environment → taking into account agro-ecological zone, meteorological settings and farm type
- No one size fits all → tailored breeding programmes for different type of farmers
- Local breeds are important for adaptability (e.g. Arsi in Highlands)

Acknowledgements

Enumerators in Sidama and Oromia Regions: A. Ashinde, A. Arega, D. Abebe, D. Nuguse, E. Kassa, F. Neguse, G. Aman, H. Solomon, I. D. Gelchu, I. Degefa, J. Mohammad, M. Gebrekidan, M. Wondu, M. Zwude, S. Kasim, S. Kinfe, T. Tafese, T. Girma, T. Tsegaye, T. Girma

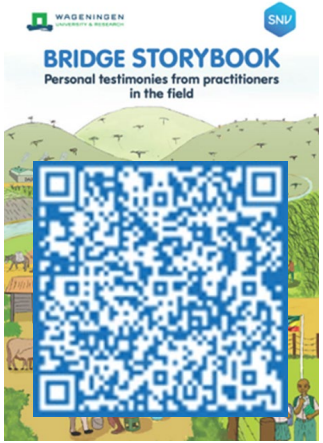
Household surveys: G. Aman & A. Beyene (MSc thesis)

Partnership: Livestock Development Institute Ethiopia (LDI)

Embassy of the Kingdom of the Netherlands

SNV Ethiopia

Thank you for your attention



WAGENINGEN UNIVERSITY & RESEARCH