

MITIGATION OF ENVIRONMENTAL IMPACTS IN DAIRY FARMING

POTENTIAL SYNERGIES AND TRADE-OFFS

Martin Seiringer
Stefan J. Hörtenhuber
Werner J. Zollitsch



Background

- Livestock Farming is criticised for
 - Green house gas emissions (GHGE)
 - Nutrient surplus leading to eutrophication
 - Inefficient utilization of potential human food
 - Multifunctionality of Agriculture widely recognized
 - Landscape aesthetics
 - Important role for Biodiversity conservation in Alpine regions
 - Delivers multiple other ecosystem services
- Area as „functional unit“ (FU) highly relevant

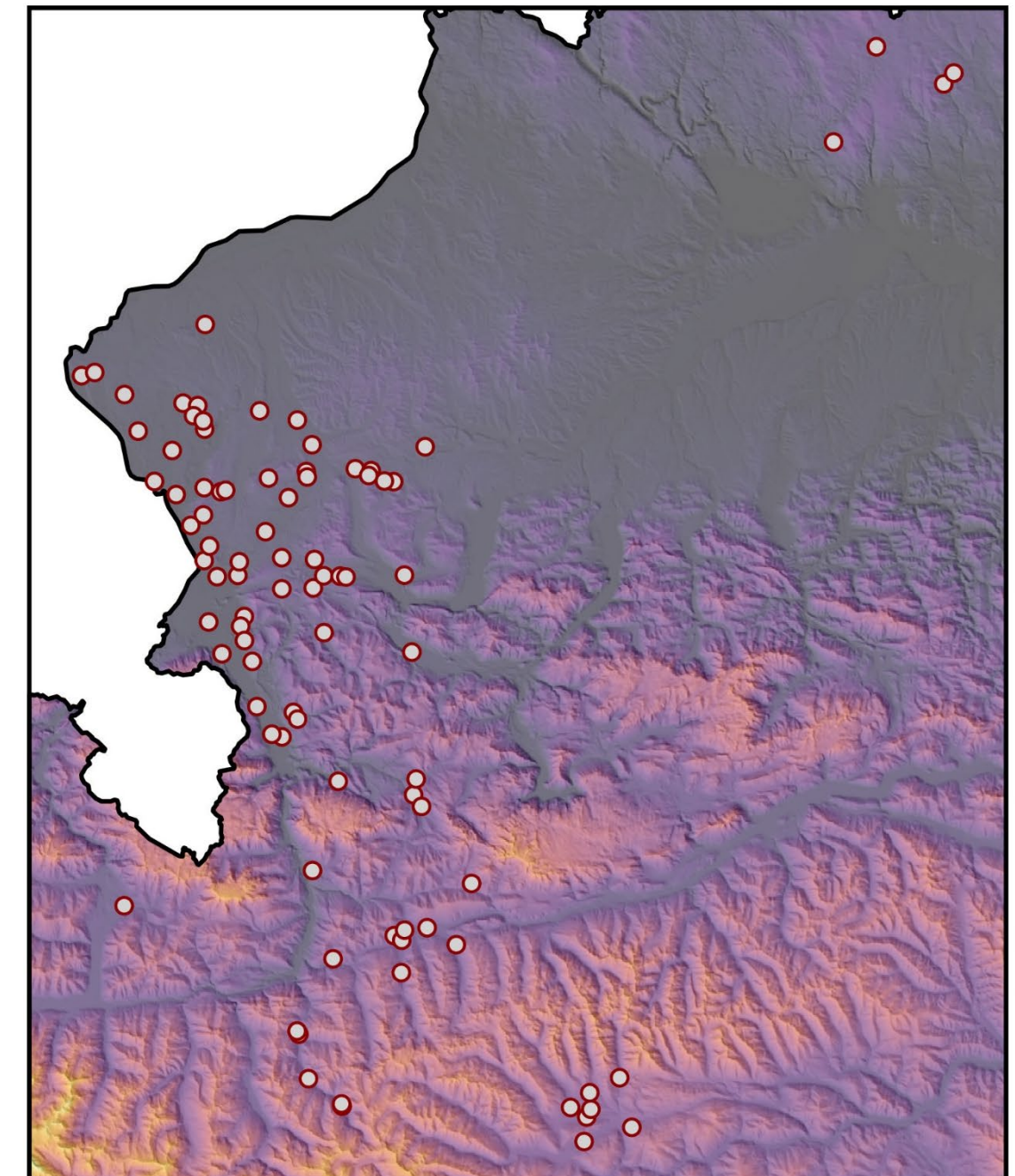
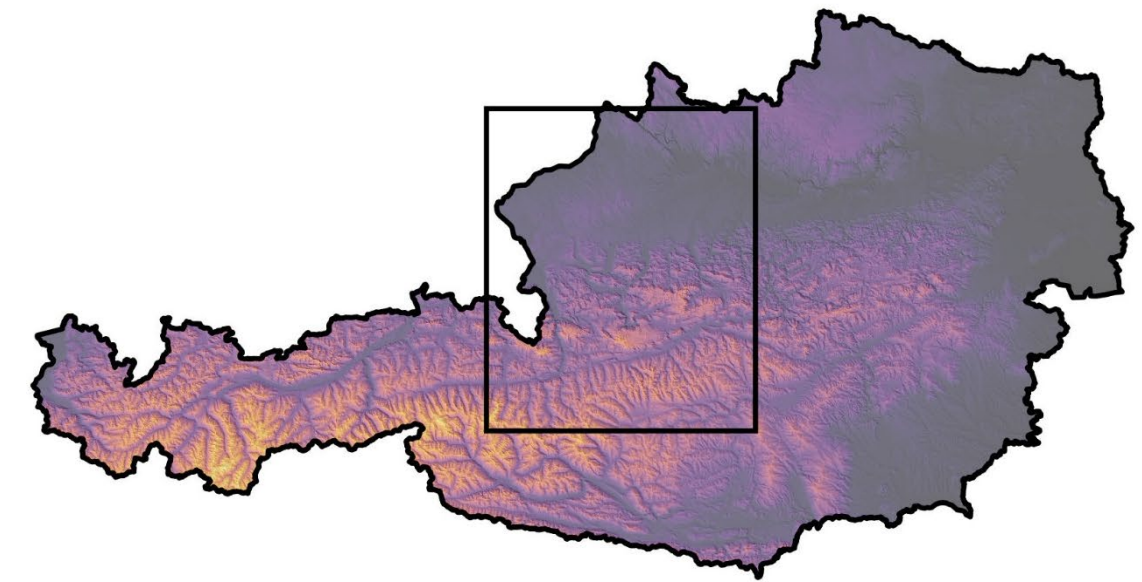
Are there trade-offs or synergies between these different perspectives?



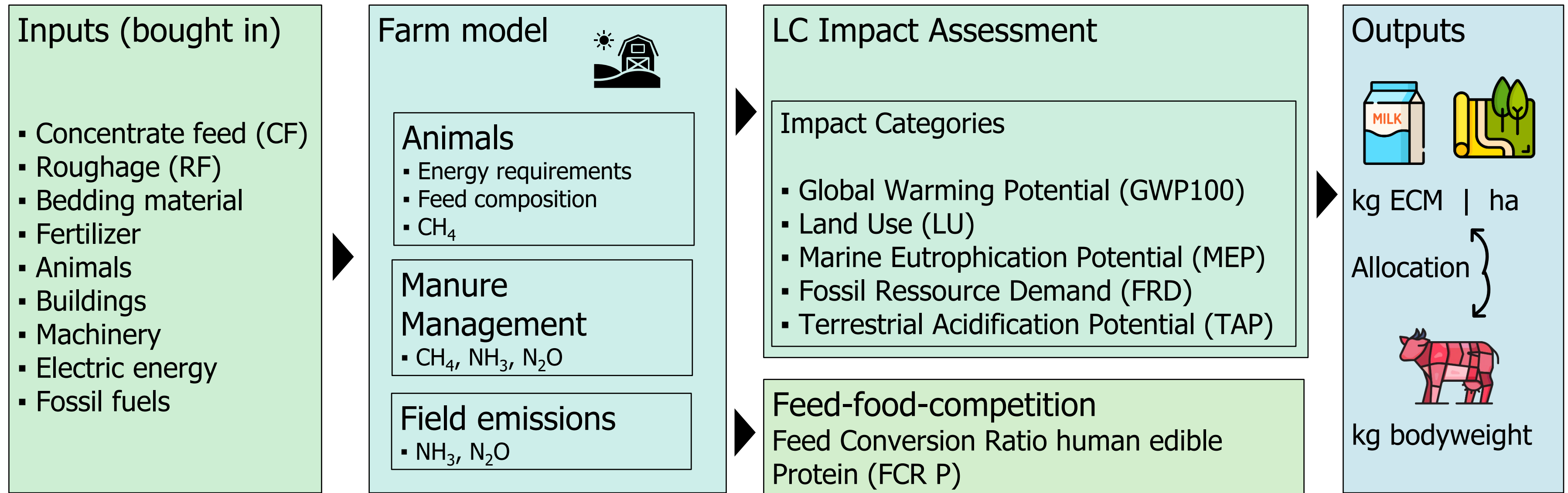
Research project overview

- Cooperation with „SalzburgMilch“ dairy company
- 89 dairy farms located in the provinces of Salzburg and Upper Austria
- high share of organic farms and permanent grassland

	Median	Min	Max	sd
kg ECM per cow	6029	3307	10983	1554
LSU per ha	1.41	0.63	3.43	0.57
Total farm land ha	20.8	4.29	63.9	12.9
Arable land %	0.0 %	0.0 %	45 %	9 %
Altitude (m asl)	581	417	1279	242
Cows (avg. in 2020)	21.9	5.15	90.5	16.7
Cows % of total LSU	68 %	36 %	97 %	14 %



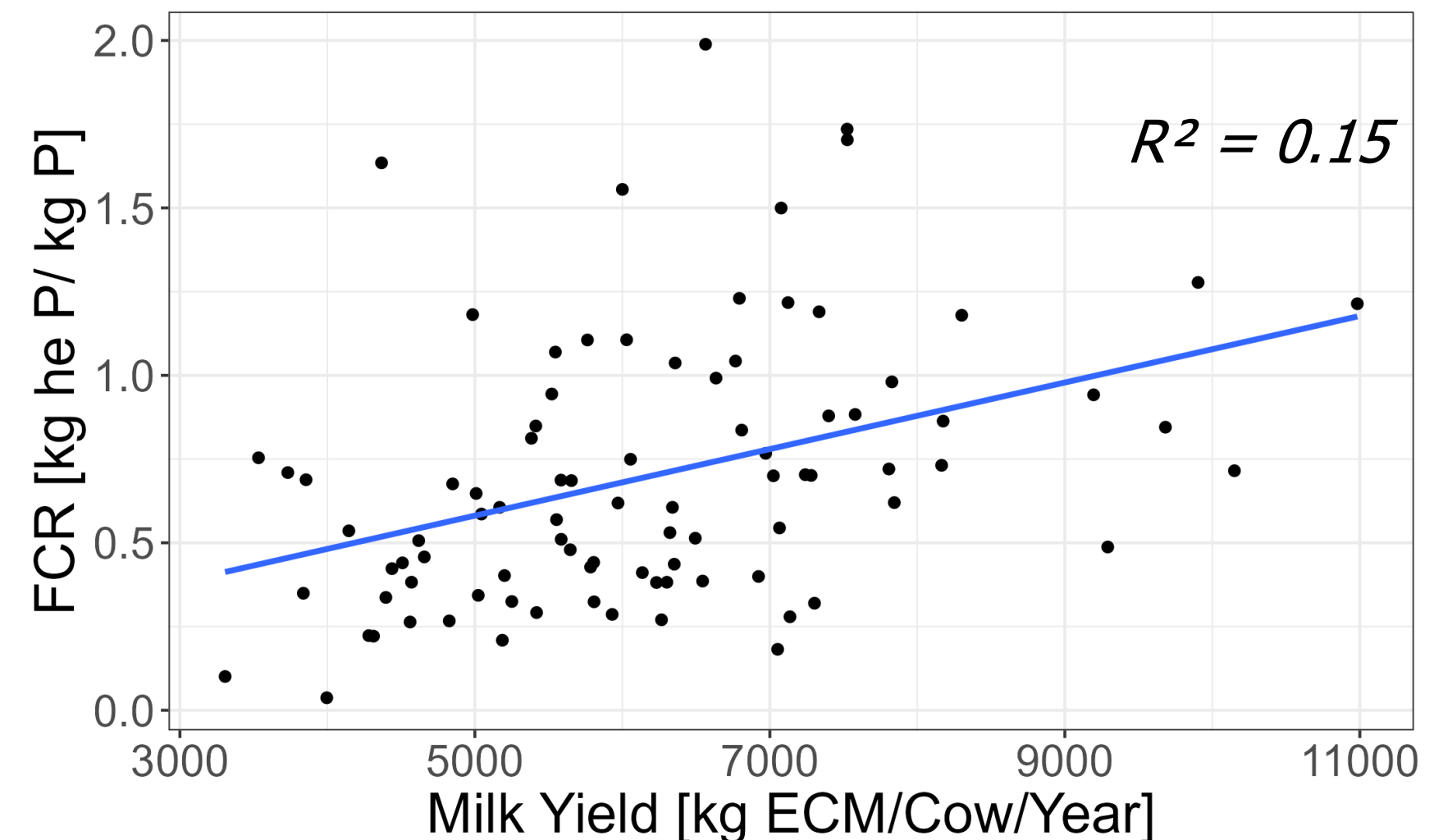
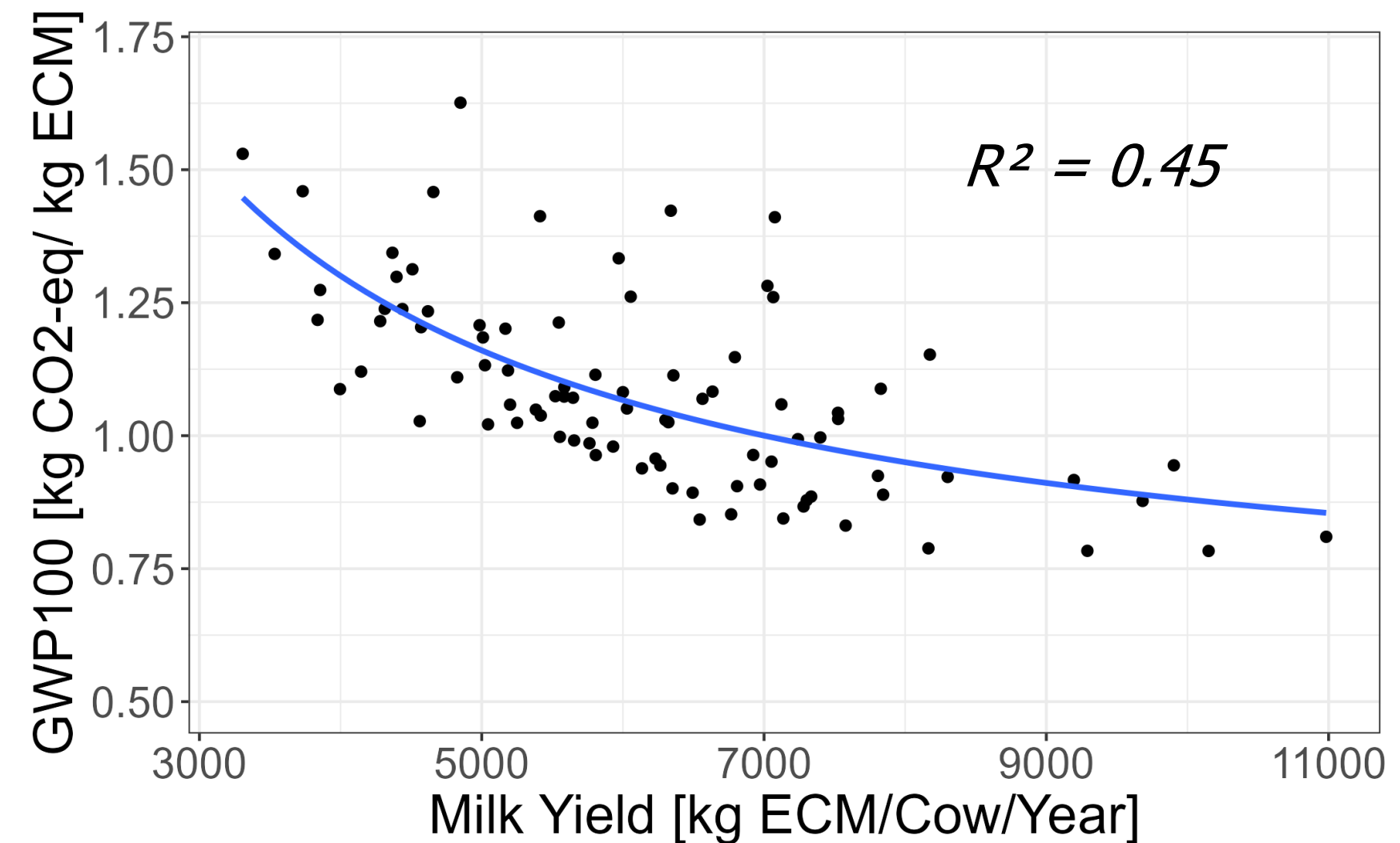
Life Cycle Assessment



- System Boundaries: Cradle-to-farm gate
- Data acquisition through online survey
- Models based on: IPCC, Austrian National Inventory and EMEP guidebook
- LCA performed in openLCA 1.10 and with ecoinvent database (version 3.8)

Milk yield, GHGE and feed-food-competition

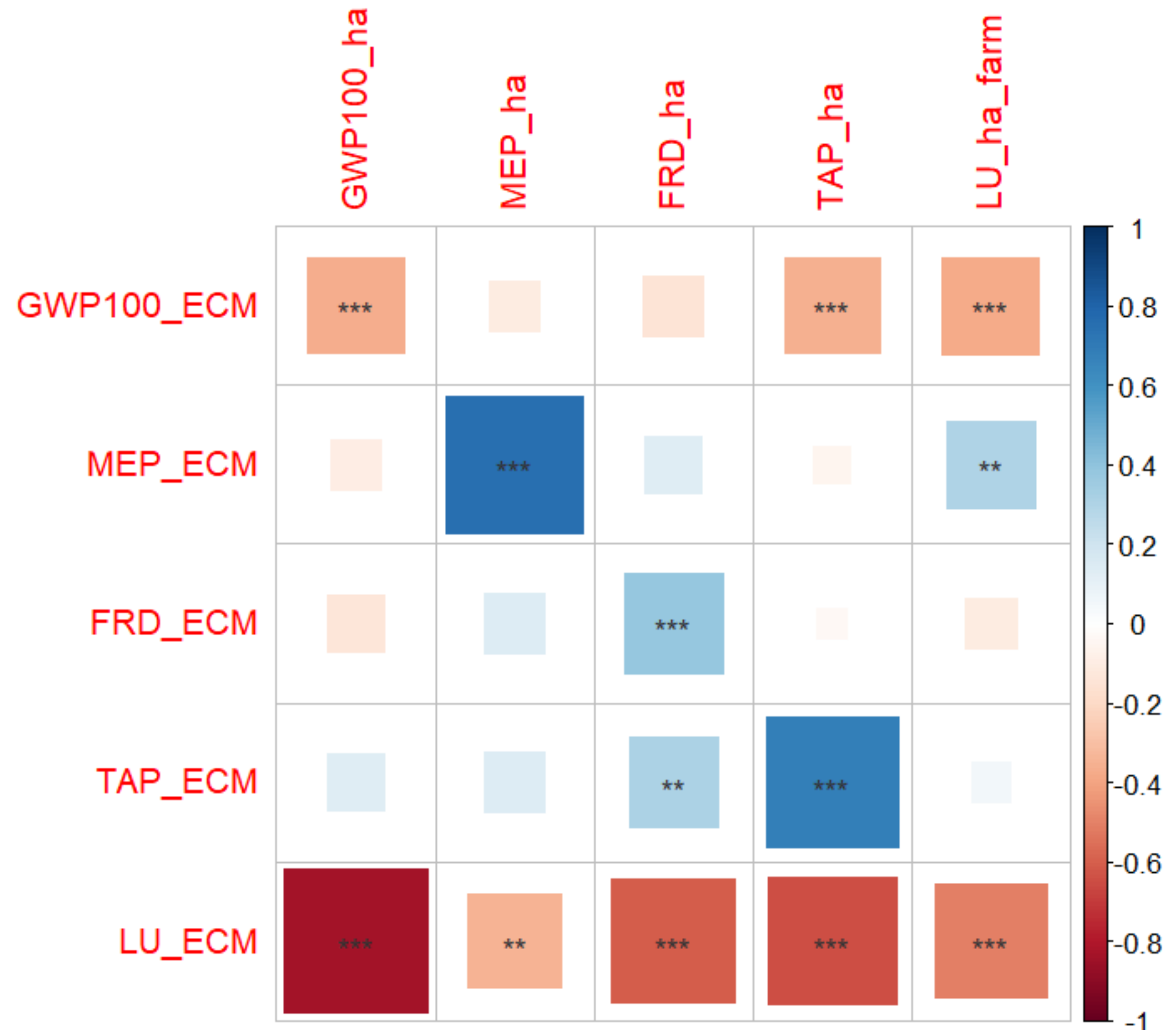
- Relatively strong association between milk yield and GWP100 per kg ECM
- Diminishing returns for GWP100 at high milk yields
- Trend of rising FCR for human edible Protein with milk yield
- Variation shows large potentials for improvement
→ efficient use of CF and maize silage



Correlation of environmental impacts with different functional units (FU)

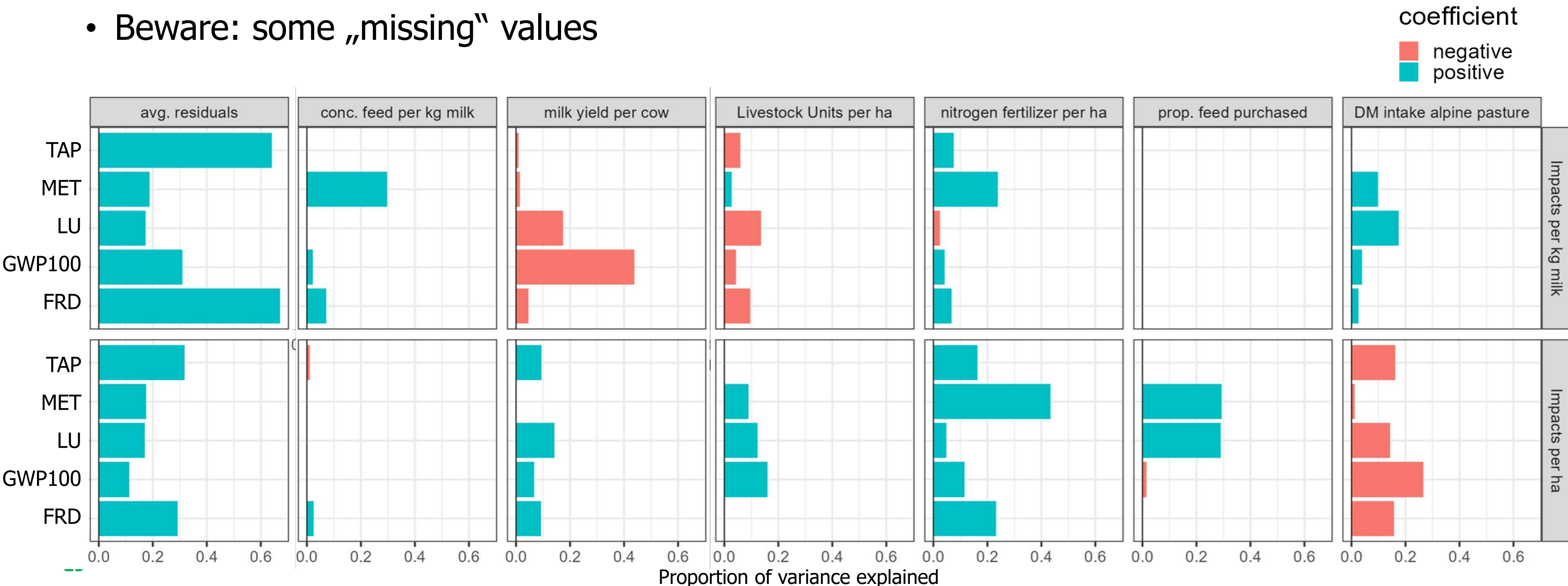
- Impacts per kg ECM correlate strongest for GWP100, LU and FRD
- Impacts per ha overall highly correlated
→ Synergies in reduction efforts
- Impacts from nutrient surplus (MEP and TAP) correlate for both FU
- LU per kg ECM shows negative correlation with all impact categories per ha
→ Trade-off or question of the function of agriculture in specific context?

LU – Land use
TAP – Terrestrial acidification
MEP – Marine eutrophication
FRD – Fossil resource demand
GWP100 – Global warming potential



Searching for causality: multiple linear regressions

- Exhaustive modelling (MuMin and relaimpo packages in R)
- Averages for 10 best models of each impact x FU combination
- Beware: some „missing“ values

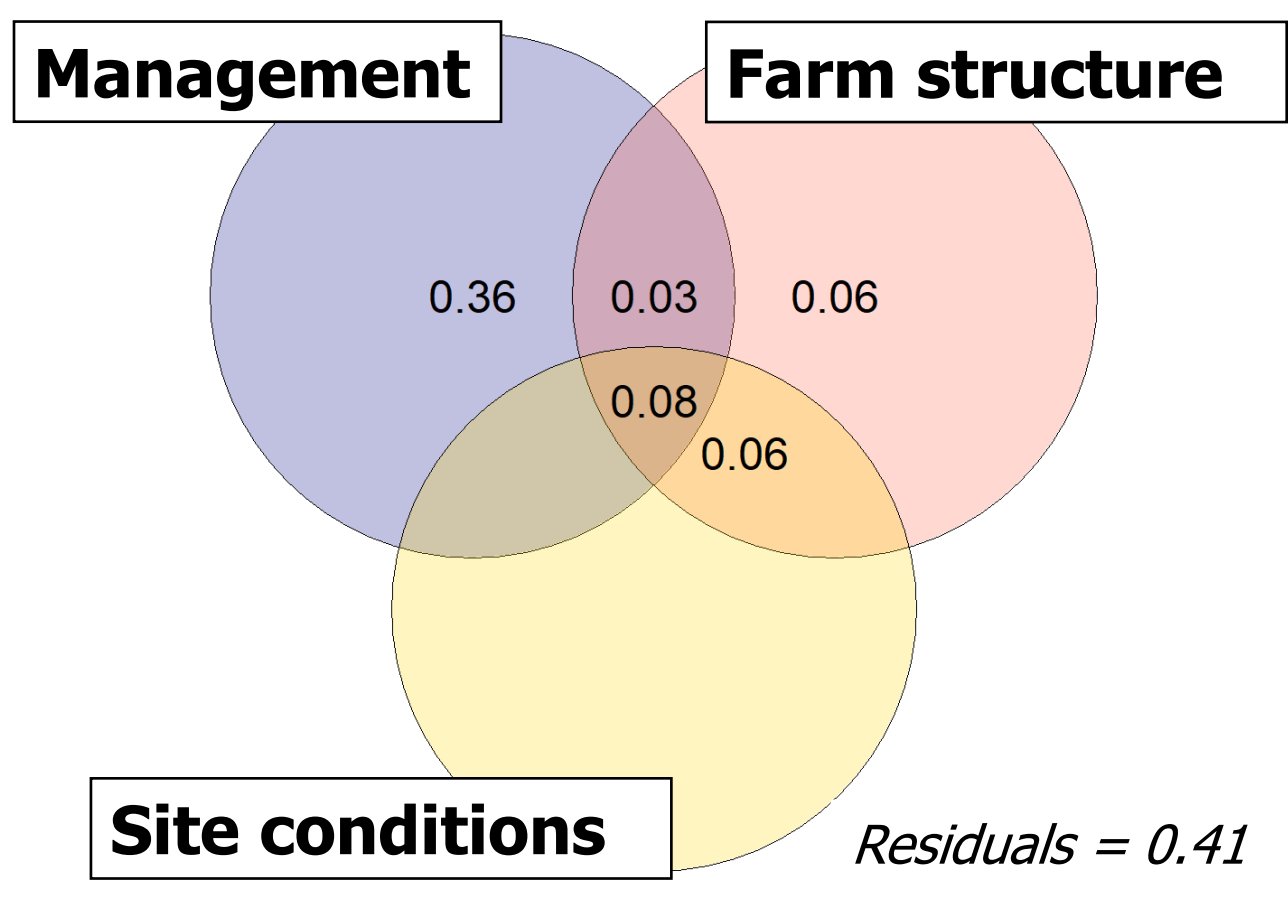


Variation Partitioning

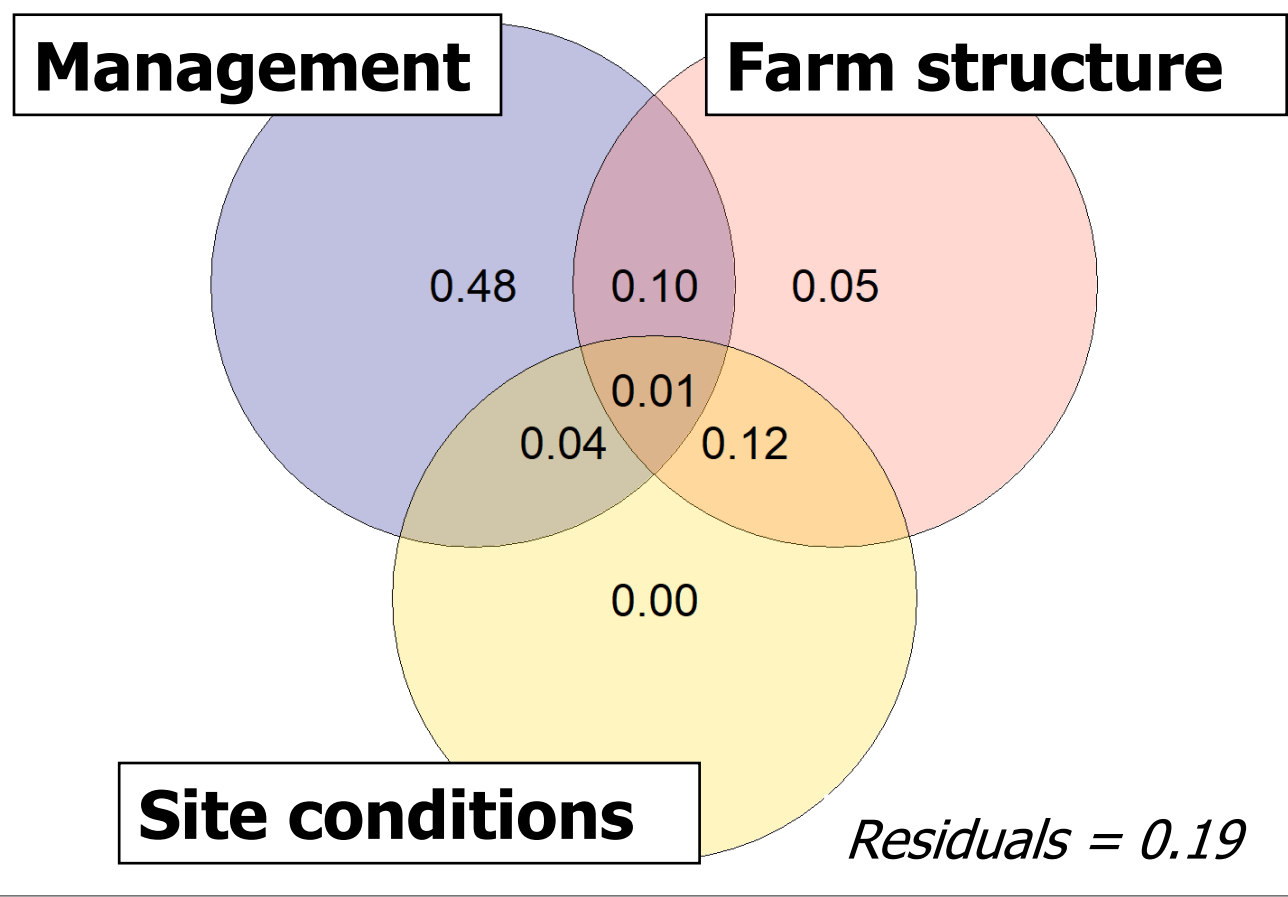
How much variation can be explained by different farm characteristics?

Management	Farm Structure	Site Conditions
ECM yield per cow	Farm size (ha)	Soil climate value
Certified organic (binary)	Cows % of total LSU	Annual precipitation
Certified haymilk (binary)	Ext. grassland %	Annual avg. temperature
CF per kg milk	Arable land %	Avg. field capacity
Roughage composition	DM intake alpine past. %	Avg. slope
Feed purch. (% MJ ME)		
Livestock Units per ha		
Mineral fertilizer kg N per ha		

Results for impacts per kg ECM



Results for impacts per ha



Conclusions

- Estimation of environmental impacts per ha is more robust than per kg ECM
 - Management factors explain most variation, highlighting opportunities for mitigation
 - Minimizing external inputs: no trade-offs, reducing farms' dependency on external factors
 - Reduces MEP per ECM and per ha
 - Improves FCR of human edible Protein
 - Potential trade-offs exist:
 - High productivity per hectare comes along with high environmental impacts per ha
 - Land Use intensity vs per product efficiency
- Functions of Agriculture differ between farms and site conditions
- Assessment of Ecosystem Services Assessment alongside LCA

Thank you for your attention! Questions?

Martin Seiringer
Institute of Livestock Sciences
martin.seiringer@boku.ac.at

BOKU University
Gregor Mendel Straße 33, 1180 Wien

SalzburgMilch

