

Relationship between environmental impact and on-farm dairy cow welfare in Parmigiano Reggiano farms

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Introduction

Parmigiano Reggiano

- One of the main dairy chains in Italy (~2800 farms, ~300 dairies, 4M cheese wheels/ year)
- Under the PDO regulation of a specific Consortium
- Strong relationship between animals, forages from local territory and cheese-making operations

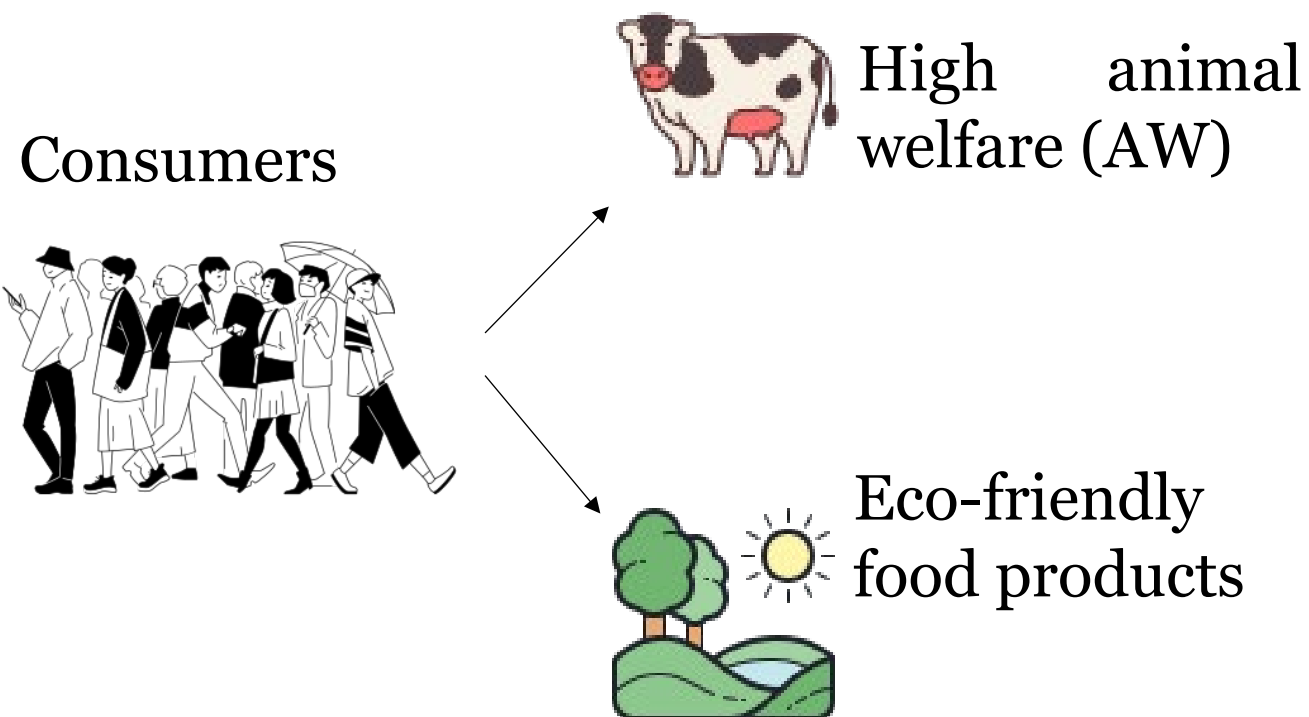


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Increasing efforts to support product quality, traceability and global sustainability

Introduction



- Few studies dealing with the two issues together
- Potential trade-offs between AW and environmental impact dimensions

(Herzog et al., 2018; Lanzoni et al., 2023)

Aim

This study aimed to assess the relationship between:

environmental impact categories, including global warming potential (GWP, kg CO₂-eq) and acidification potential (AP, g SO₂-eq)

AND

on-farm animal welfare traits in Parmigiano Reggiano (PR) farms

Based on 240 farms enrolled within PR Consortium



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Data collection

Assessment approaches:



Environmental impact

Animal welfare

Attributional, cradle-to-farm gate Life Cycle Assessment

Functional units: 1 kg fat-and protein-corrected milk, 1 m² of agricultural area

Categories: global warming potential (kg CO₂-eq) (no land-use change), acidification potential (g SO₂-eq)

System boundaries:

- Animal and manure management
- On-farm feed production
- Off-farm feeds
- Bedding materials and energy sources

Data collection

Assessment approaches:

Environmental impact



Animal welfare

Method: Classyfarm - Italian official method welfare evaluation scheme for dairy farms

Each farm visited by trained veterinarians

3 different aspects (areas) related to potential causes of low animal welfare:

Area A: farm management (MGT),

Area B: farm structure and equipment (SAE),

Area C: animal-based measures (ABM)

Each area: score from 0 (the lowest level of animal welfare) to 100 (the highest level of animal welfare)

Statistical analysis

Pearson's correlation analysis:

GWP per unit of milk

AP per unit of milk

GWP per unit of area

AP per unit area

AP locally-emitted, per unit of farm area

MGT (farm management)

SAE (farm structure and equipment)

ABM (animal-based measures)



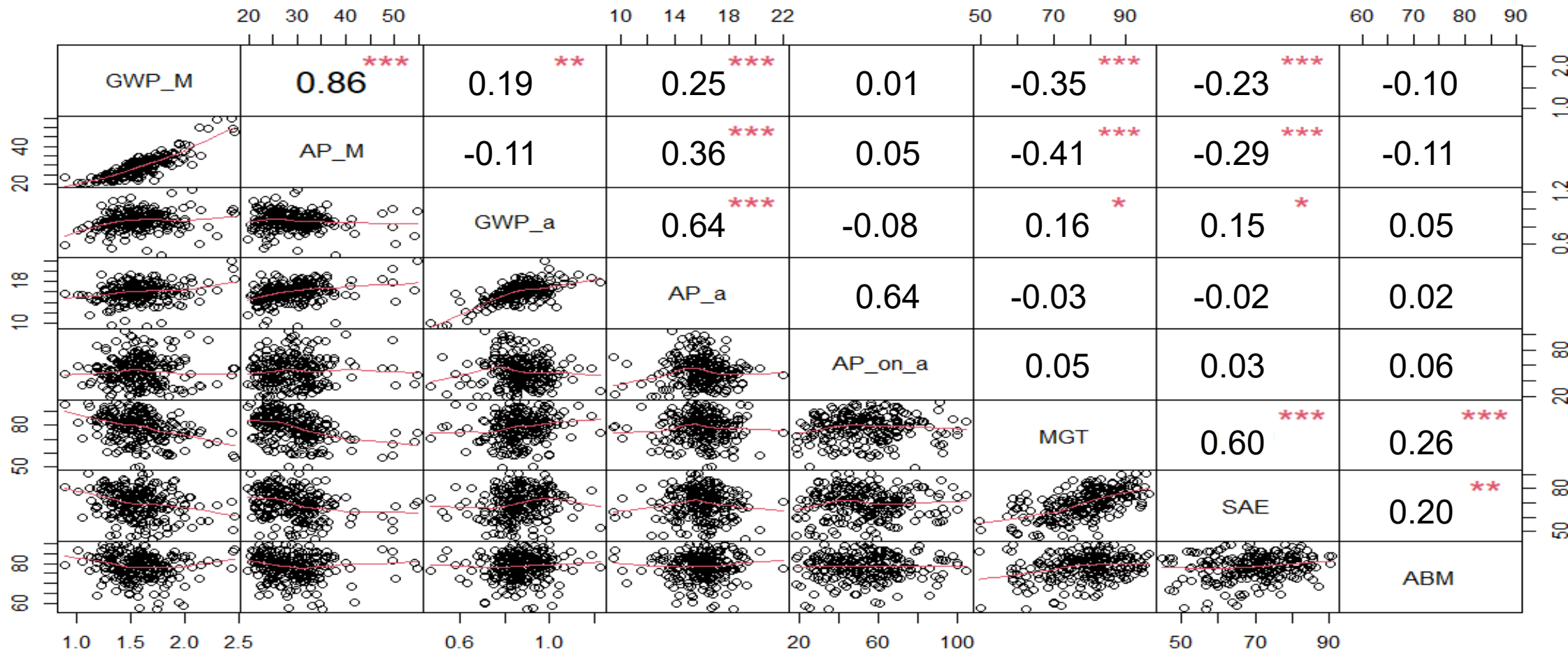
Results: farm traits

Variable	Unit	Mean	SD	Min	Max
Dairy cows	n	149	162	15	1179
Livestock units	n	235	248	19	1773
Holstein Friesian, presence	% cows	83	29	0	100
Milk yield	kg FPCM / 305d	7902	1816	3491	13260
Milk protein content	%	3.37	0.18	2.56	4.31
Milk fat content	%	3.77	0.25	3.29	5.20
Farmland area	ha	107	149	9	1800
Stocking rate	cows / ha	1.55	0.78	0.31	4.33

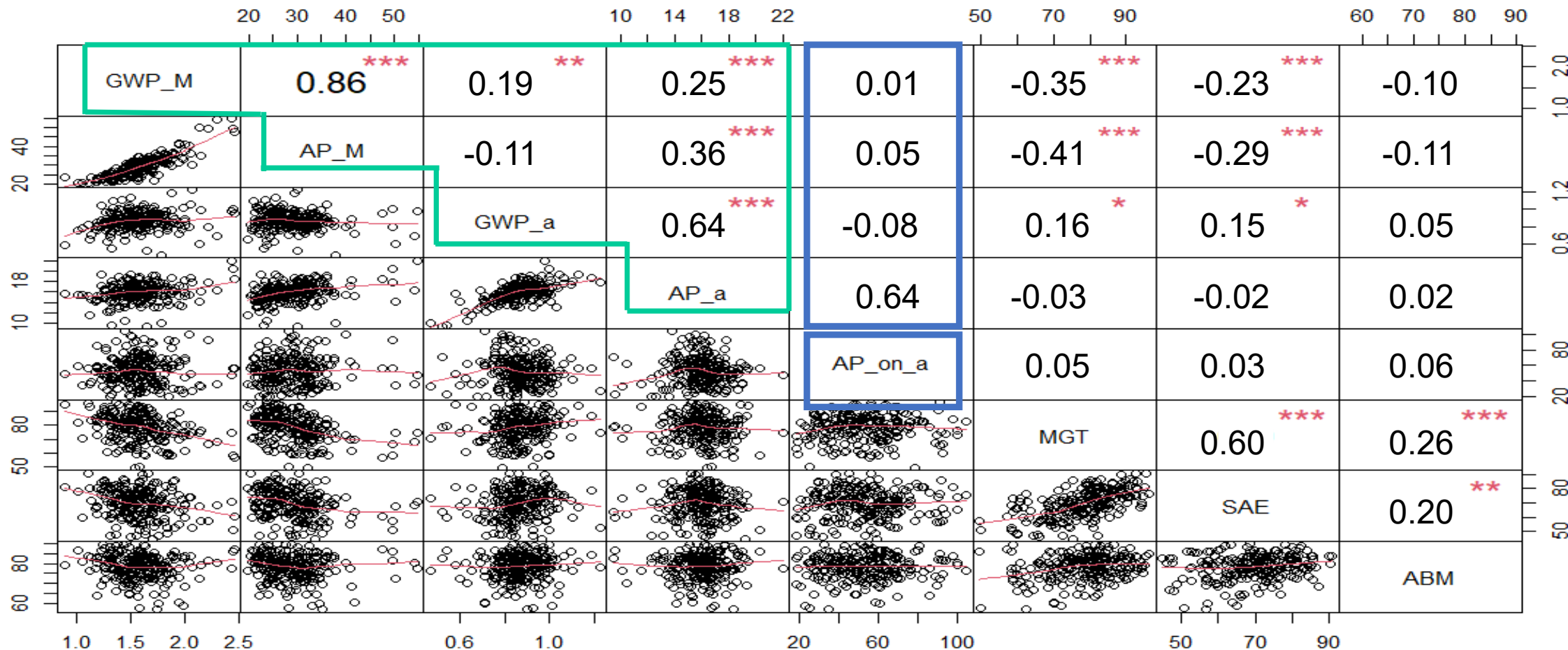
Results: sustainability

		Mean	SD	Min	Max
GWP_M, milk	kg CO ₂ -eq / kg FPCM	1.57	0.25	0.89	2.45
AP_M, milk	g SO ₂ -eq / kg FPCM	29.0	5.7	19.8	54.6
GWP_A, area	kg CO ₂ -eq / m ²	0.87	0.10	0.47	1.22
AP_A, area	g SO ₂ -eq / m ²	15.9	1.7	9.5	22.0
AP_A local, farm area	g SO ₂ -eq / m ²	53.4	17.9	18.9	104.4
Animal welfare scores					
farm management (MGT)	Range 0-100	78.2	9.5	49.5	96.4
farm structure and equipment (SAE)	Range 0-100	69.6	9.8	44.9	90.8
animal-based measures (ABM)	Range 0-100	78.0	6.3	56.8	89.7

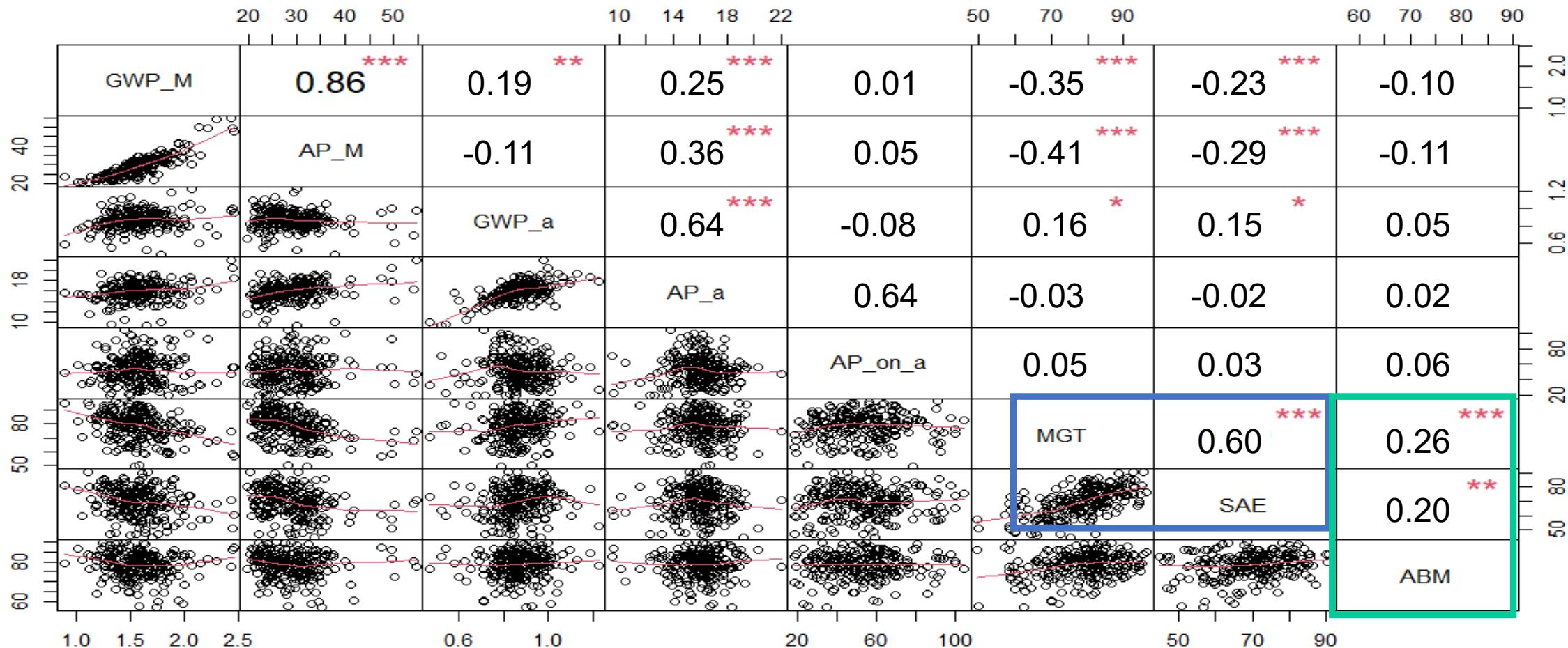
Results: AW-LCA relationships



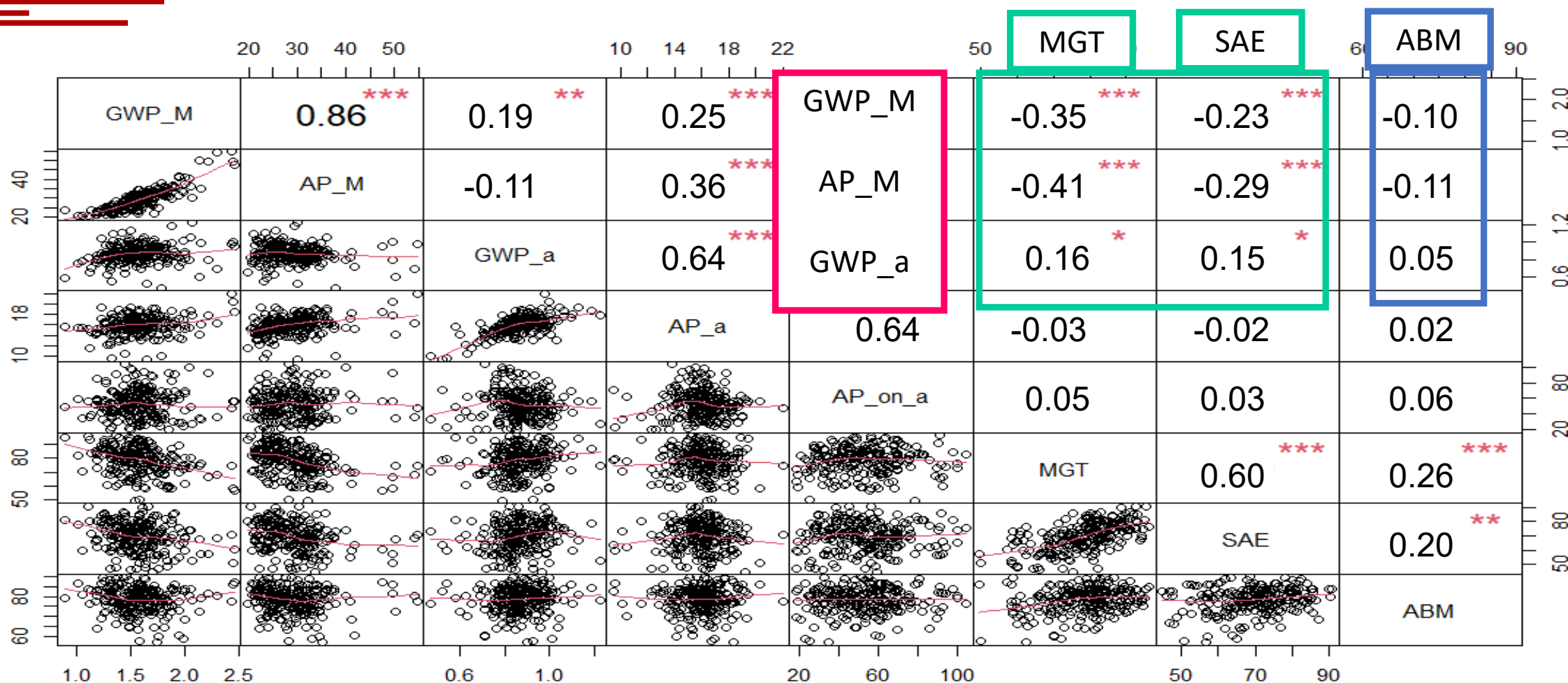
Results: AW-LCA relationships



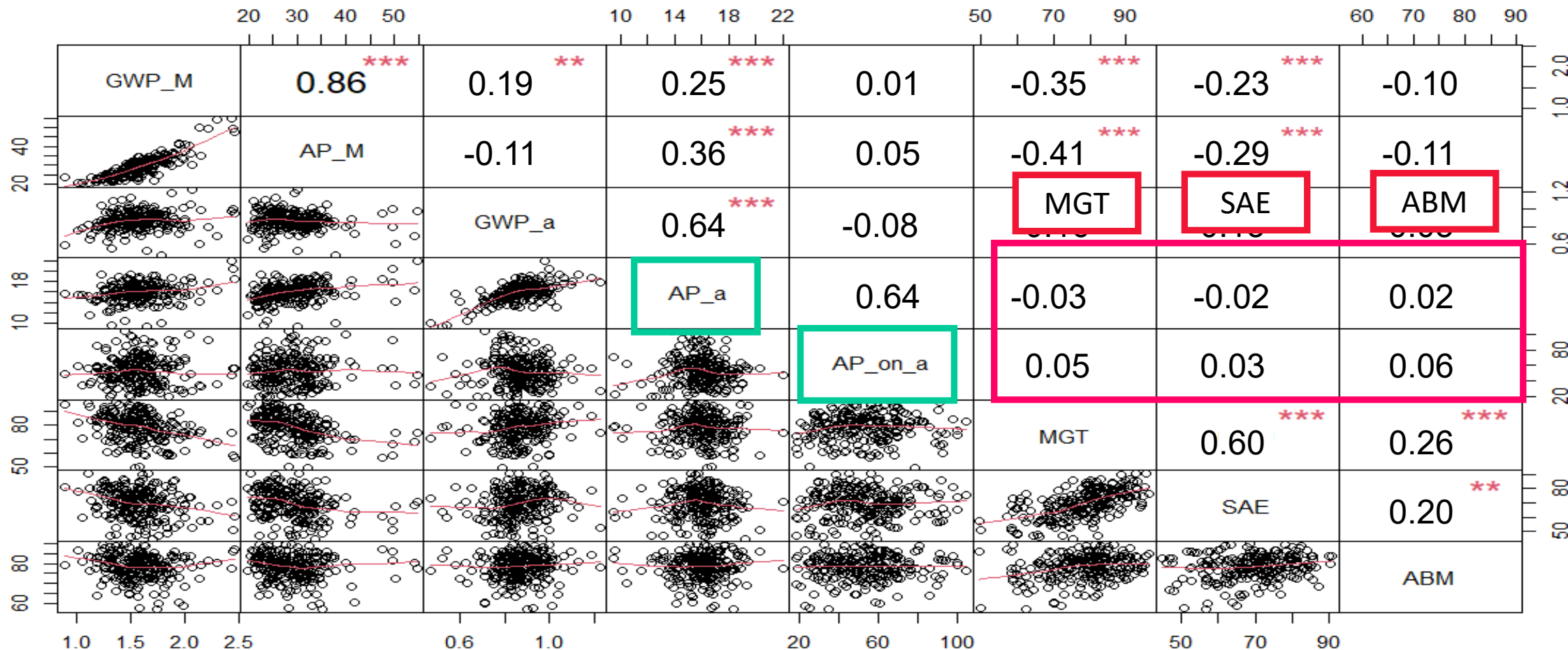
Results: AW-LCA relationships



Results: AW-LCA relationships



Results: AW-LCA relationships



Conclusions

- The need to consider environmental sustainability and AW together is increasing
- As expected, general positive correlations were found between impacts
- Negative correlations between GWP and AP per unit of milk and AW scores related to management and structures 😊
- No correlations between impacts and animal-based measures → possibility to work on the single issues with low risk of negative effects on the others
- Relationship between impacts per unit of area and AW scores → more complex (attention on AP, a local-based and area-related impact)

We need to extend the analysis of the interactions between LCA and AW in order to address farmers and stakeholders towards a global sustainable animal production

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In particular this contribution is related to the Spoke 5



Thank you for your attention



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Issues covered by Classyfarm

Management:

- number of farm workers and their level of expertise,
- the method of supplying feed and drinking water to the different livestock categories (lactating and dry cows, heifers, calves),
- the management of sick animals,
- barn cleanliness:

Structure:

- presence or absence of external paddocks,
- the spaces allocated for resting and feeding,
- availability of drinking troughs,
- floor and bedding conditions,
- the presence and management of a specific area for diseased animals,
- the status of milking parlors
- the condition of the equipment for maintaining an optimal internal climate

Animal-based measures:

- the animals' nutritional status assessed by body condition score (BCS),
- cleanliness,
- prevalence of diseases (e.g. lameness, mastitis, ketosis, abscesses, reproductive tract infections),
- the mortality rate per animal category