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Assessment of sustainability indicators on farms under real-life conditions

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Outline

- Introduction
- Project *SustainFarm*
- Analysis: Correlation analysis
- Feedback to farmers
- Conclusion

Introduction

- **Sustainable agriculture** is a prerequisite for **future-oriented food production.**
- Development of a **scientifically sound set of quantitative indicators** of the most relevant aspects of sustainability for all **three pillars** of sustainability (**ecologic, economic and social**) -> Final Report March 2017:

Roesch et al., 2017: Comprehensive Farm Sustainability Assessment, Agroscope Science, 47, 248 p

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Main aspects of sustainability

Environmental Impacts

- Resource use (non-renewable, P, K, water, land)
- Global warming (CO_2, CH_4, N_20)
- Eutrophication and acidification
- Ecotoxicity (aq. & terr.)

- Biodiversity
- Soil quality

Economic sustainability

Rentability/ Liquidity/ Stability

Social Sustainability

- *Human well-being*, work-load
- *Animal welfare*
- Visual quality of landscape

Project SustainFarm
Main Objectives

1) Application of sustainability indicators under **real-life conditions** on a sample of **12 Swiss farms** (**feasibility**)
2) Evaluate **entire process** from data acquisition to computation of final indicators (and **feedback** to farmers)
3) Check **accuracy** and **plausibility** of indicator set
4) Check **acceptance** and **usefulness** among farmers

Duration of project: Jan 2016 – Dec 2019

Milestones

Aug 2018: 1st test phase completed
May 2019: 2nd test phase completed
Dec 2019: Final report

Project SustainFarm
Sample: Principal characteristics

	UAA [ha]	LU [LU]	Arable land [%]	Grassland [%]	EFA [%]
Mountain farms					
MT1	30.9	79.2	**0**	95.5	13.4
MT2	23.2	25	**0**	**96.1**	19.9
MT3	**53.4**	77.5	2.2	86.1	11.7
MT4	50.1	44.8	**0**	64.1	**62.3**
MT5	**13.4**	21.2	10.1	83.6	8.9
Crop farms					
ARAB1	33.7	4.5	61.2	14.6	30.6
ARAB2	50.7	11.4	**90.1**	6.9	8.7
ARAB3	22.7	**0**	74	**0.8**	17
Int. animal farms					
PIG1	22.9	57.3	27.7	65.3	9.6
PIG2	25.2	84.5	6	90.5	**8.6**
PIG3	22.8	**95.5**	11.2	82.6	10.7
PIG4	18.0	51.7	24.2	68.9	11.4

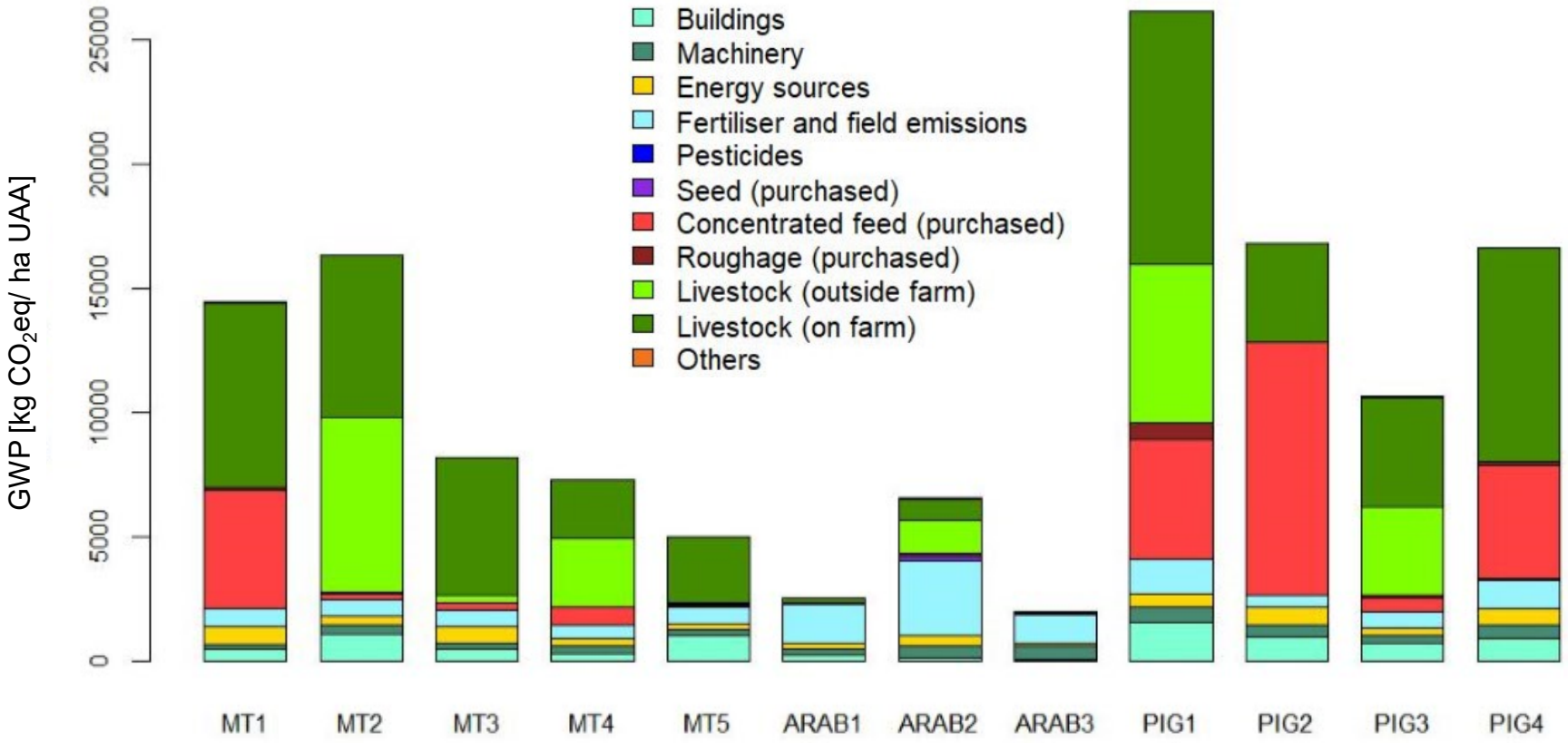
Results
Environmental impacts

- Resource use (non-renewable, P, K, water, land)
- Global warming (CO_2, CH_4, N_20)
- Eutrophication and acidification
- Ecotoxicity (aq. & terr.)

- Biodiversity
- Soil quality

Global Warming Potential (GWP)

Functional unit: ha UAA



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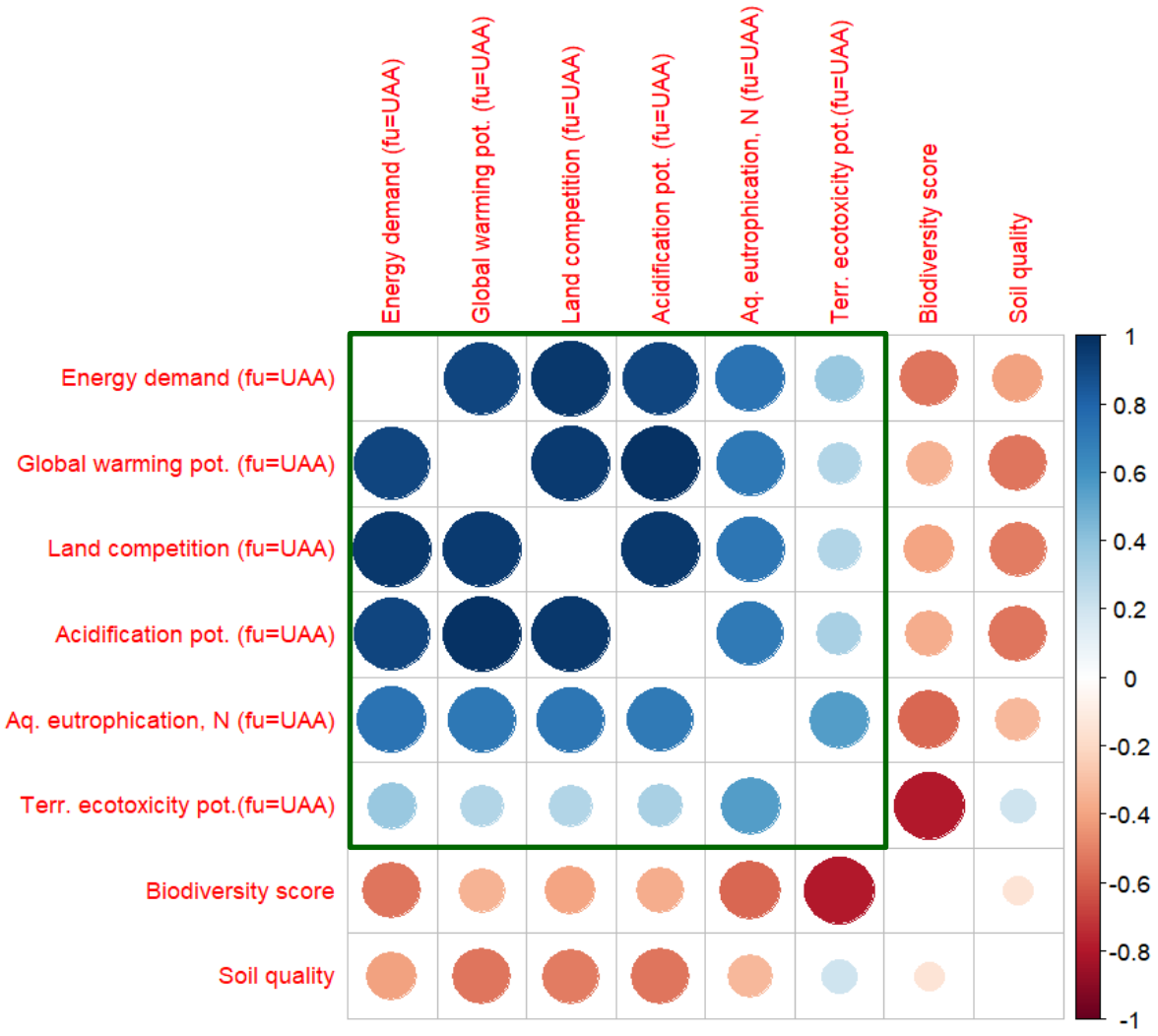
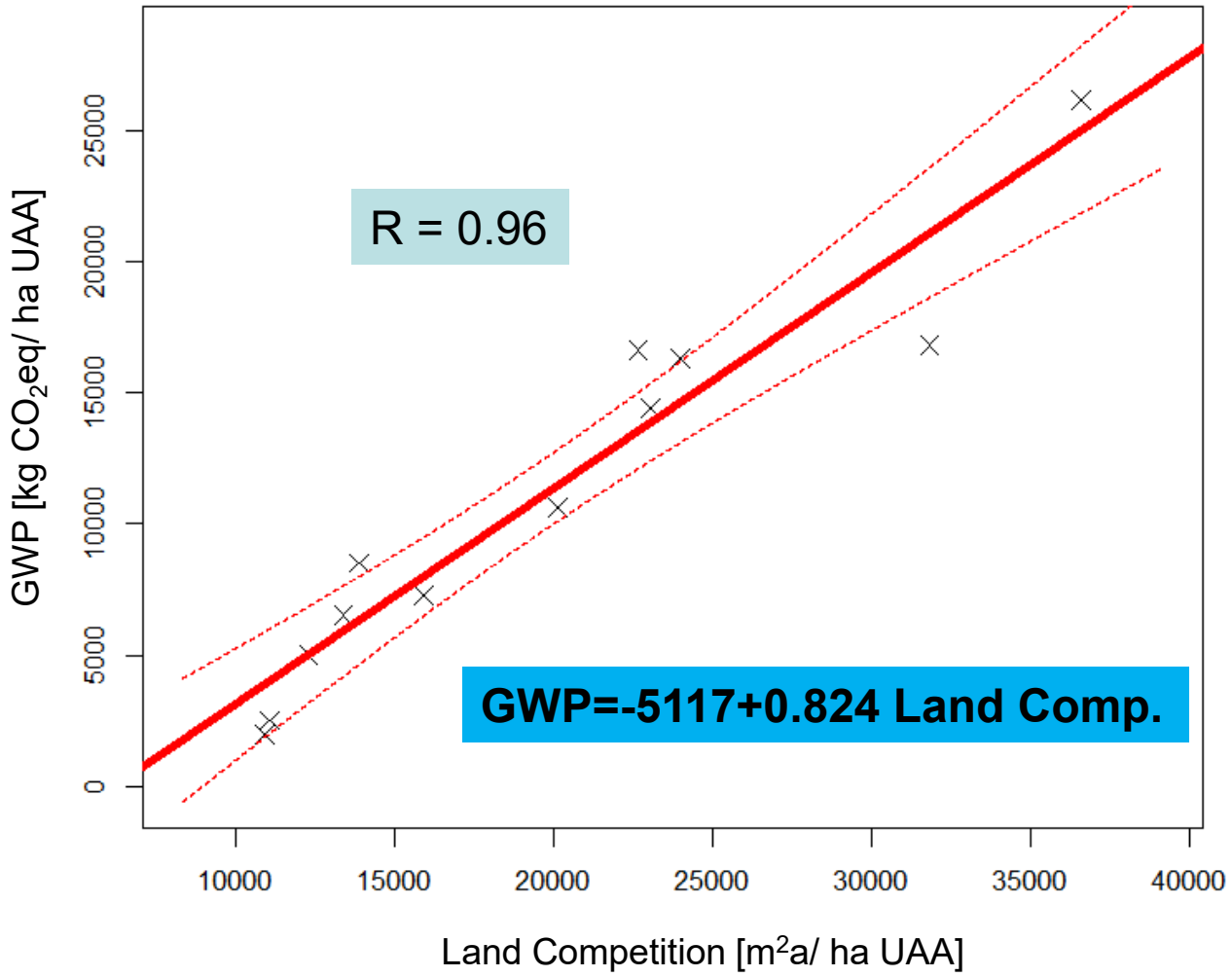
Environmental impacts
Correlation matrix (Spearman)



GWP vs. Land Competition



Economic & Social Sustainability

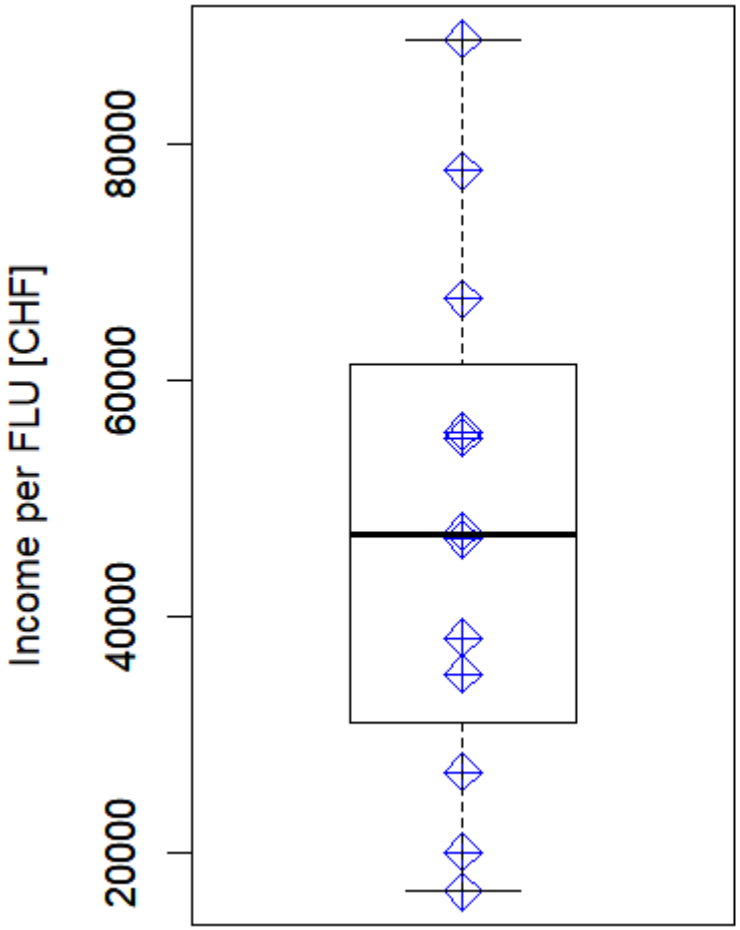
Rentability
- Income per Family Labour Unit (FLU)
- Return on capital

Liquidity
- Cash flow ratio
- Dynamic gearing ratio

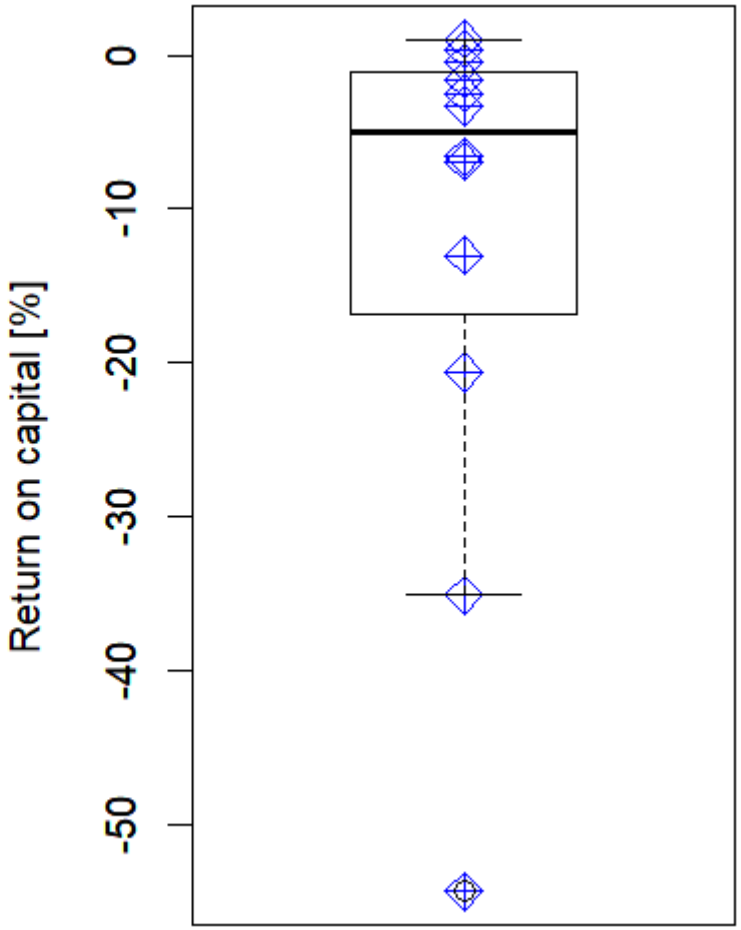
Stability
- Investment intensity
- Capitalisation ratio

- **Work-load, (human well-being)**
- **Visual quality of landscape**

Economomic indicators - rentability



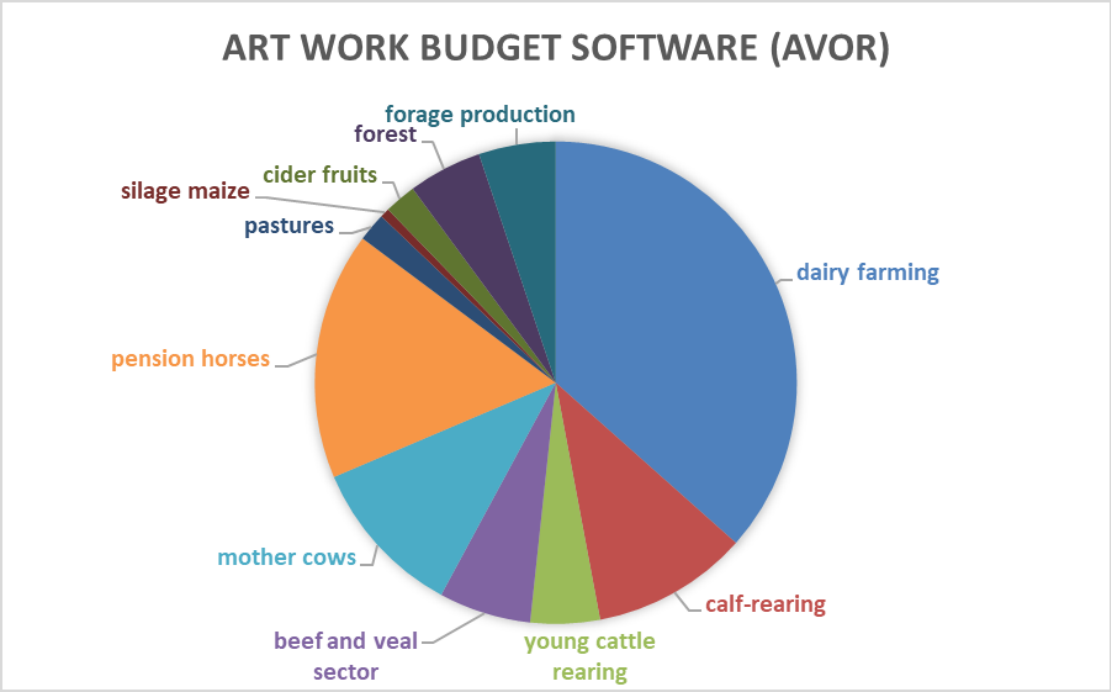
FLU= Family Labour Unit



Return on capital $= \frac{\text{Profit after renumeration of FLUs}}{\text{farm assets}}$

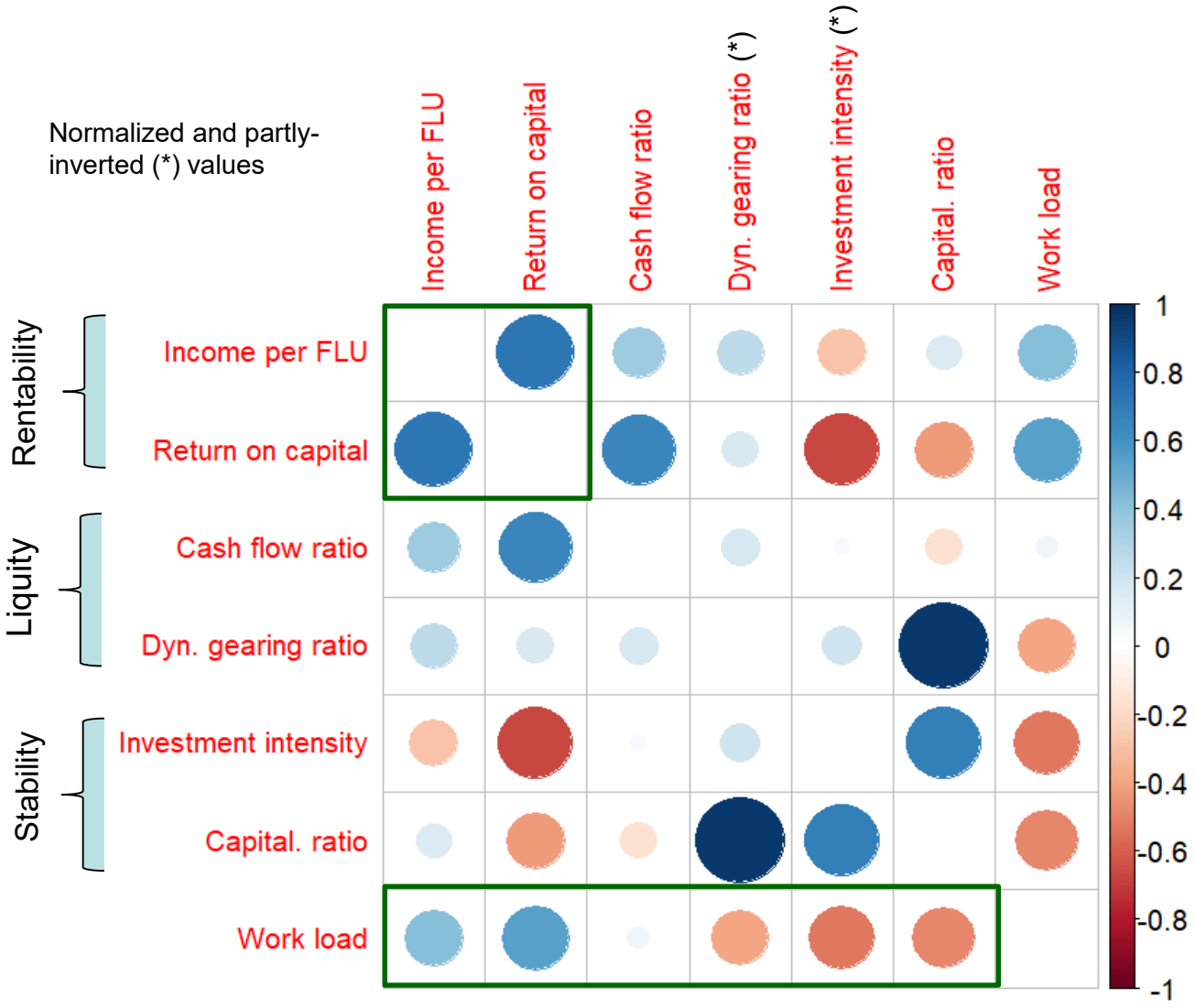
Temporal Workload: Farm MT3

Total working hours (computed with AVOR)	8'240 h
Total available working hours (1 SLU= 2800 h)	10'640 h
Indicator workload	0.774

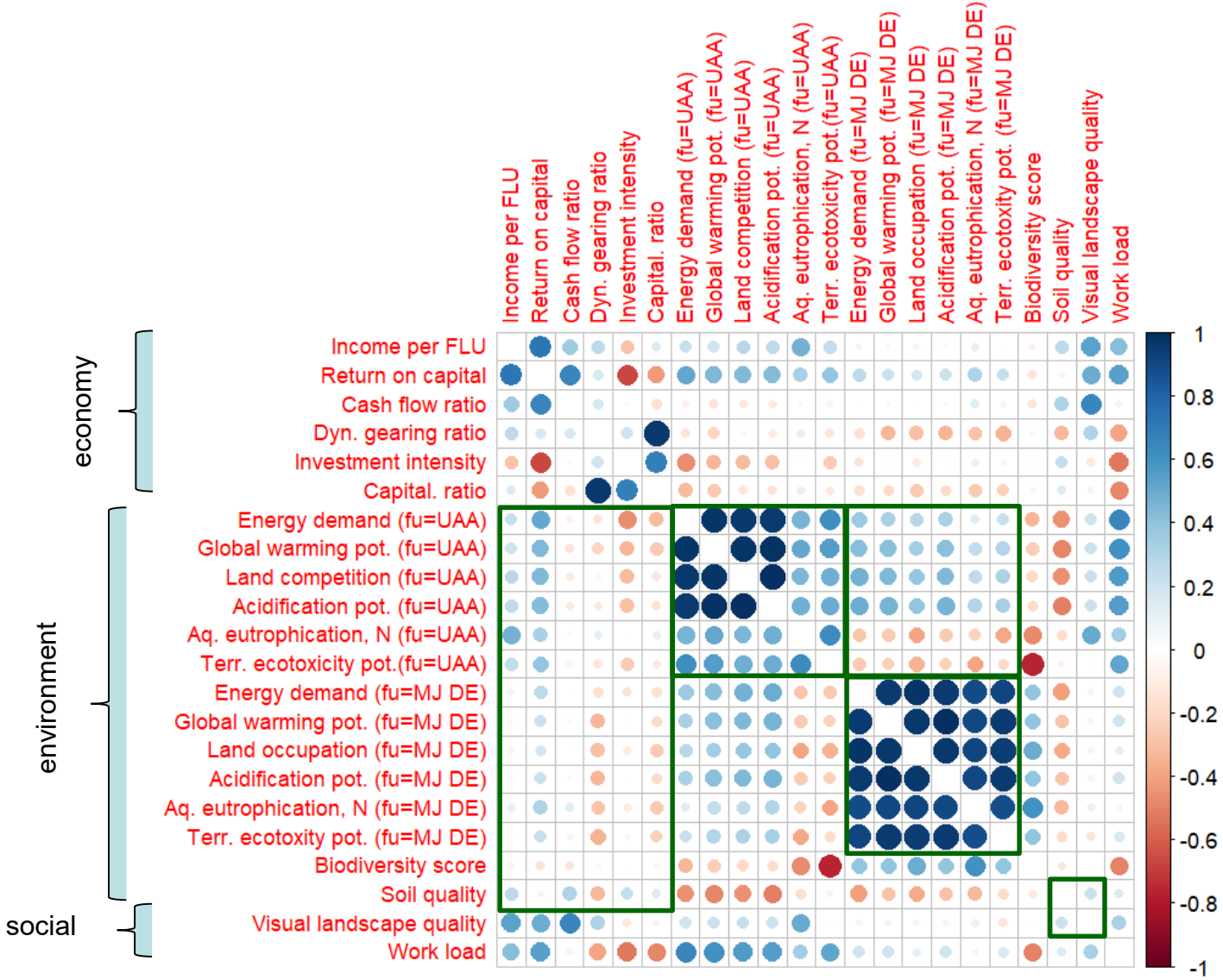


AUU = 53.4 ha
LU = 77.5
Grassland: 86%
EFA: 12%

Econonomic Ind. & Workload – (Spearman-) correlations



Correlation analysis (Spearman)



Feedbacks to farmers

Farmers

- are generally interested in the topic of sustainability
- think and like to learn new things
- act positively
- accepted the acquisition of high amount of data
- partly suggested to collect more data (field work)

Conclusion

- ✓ Practical test ("1st test phase") was successful (data collection, computation of indicators, feedback interviews to farmers)
- ✓ Data quality is reasonable, indicator provide interpretable measures for various aspects of sustainability
- ✓ Farmers are interested in results and show active participation

BUT

- Data acquisition must be optimized
- Further work needed for checking the data for plausibility
- Application on larger sample remains very ambitious with current procedure -> project **SALCAFuture**: IT-Tool

Conclusion (Correlation analysis)

- ✓ **Sample size critical…**
- ✓ Generally quite low correlation among sustainability indicators -> "full picture" requires "many" indicators
- ✓ Environmental impacts are generally highly correlated
- ✓ Higher soil quality is related to beneficial environmental impacts
- ✓ Biodiversity and visual landscape quality show no relationship
- ✓ High biodiversity scores are related to low terr. ecotoxicity
- ✓ Synergies/ trade-offs between environmental and economic indicators are generally low
- ✓ Rentability indicators are positively correlated (omit one?)
- ✓ Higher temporal workload does not necessarily lead to higher economic performance ☺

Outlook – next steps

- 2nd test-phase with improved data acquisition
- Final report on the findings in project *SustainFarm*

- SALCAFuture: Development of sophisticated IT-Tool

- Ongoing development of some aspects in socio-economic pillar (e.g., animal welfare)
- Normalization/ Aggregation

Thank you for your attention

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