5TH GLOBAL FOOD SECURITY CONFERENCE | 9-12 April 2024 Leuven, Belgium
Towards equitable, sustainable and resilient food systems

Pathways

Sustainability performance of innovative livestock systems in Europe

Authors

E. Diaz Vicuna[1], N. Adams[2], L.G. Smith[2,3], C. Forte[1], A. Hessle[4]

1. Dept. of Veterinary Sciences, University of Turin, Grugliasco (TO), Italy
2. School of Agriculture, Policy and Development, University of Reading, Reading, UK
3. Department of Biosystems and Technology, Swedish University of Agricultural Sciences, Lomma, Sweden
4. Swedish University of Agricultural Sciences, Dept. of Applied Animal Science and Welfare, Skara, Sweden

Presented by
Dr. Nina Adams

Introduction

- European livestock systems are facing **sustainability challenges** related to environmental impacts (e.g., pollution), economic concerns (e.g., profitability), and social issues (e.g., animal welfare)
- The PATHWAYS project is working with 15 farmer groups (Practice Hubs) implementing **innovative practices** in animal production to understand how livestock systems in Europe can become more sustainable and resilient
- Sustainability assessments were performed to learn about **strengths and trade-offs** of each Practice Hub and help identify best-practice for wider integration in livestock systems, improving the sectors overall sustainability

Methods

- Data was collected on **106 farms** from nine European countries using the **Public Goods Tool** (Paraskevopoulou et al., 2020) and includes quantitative and categorical data covering **12 different categories (spurs)** *(Figure 1)*
- Statistical analysis in R (R Core Team, 2023) included **correlation analysis** to measure strength and direction of association between the different spurs; **heatmap cluster analysis** (Gu, 2022; Gu et al., 2016) to identify patterns in the sustainability performance of the different farms, and **Kruskal-Wallis analysis** (de Mendiburu, 2023) to determine statistical significance of differences between clusters

Results

- Spearman's correlation revealed **33 significant correlations** *(Figure 2)*
- Heatmap analysis led to the identification of **five clusters**, created on the basis of the individual farms' scores for each spur *(Figure 3)*
- Clusters 1 and 2 are dominated by pig and poultry production; while cluster 3, 4 and 5 were primarily composed of beef and dairy cattle farms
- Kruskal-Wallis analysis revealed **statistically significant differences between the clusters**, e.g., regarding agri-environmental management ($H = 64.72$, $df = 4$, $p = 2.95e\text{-}13$) *(Figure 4)*

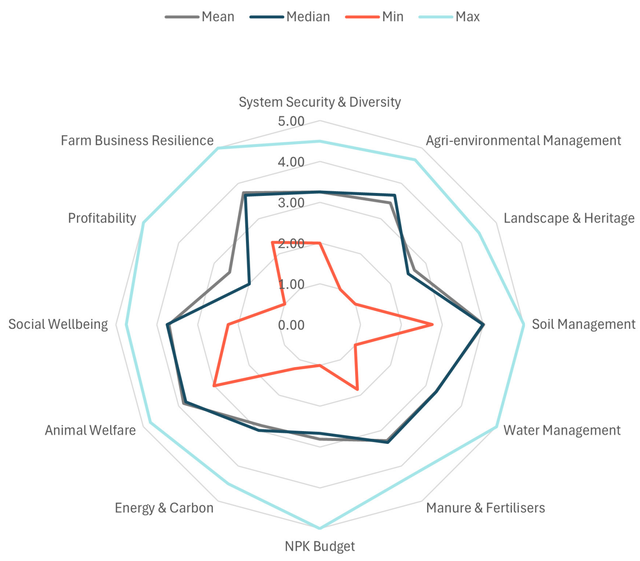

Figure 1: Public Goods Tool scores across all farms

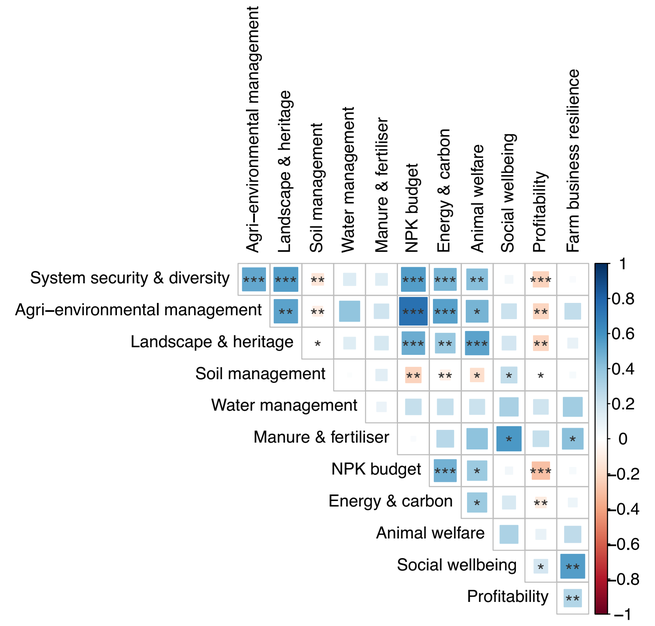

Figure 2: Correlations between categories of the Public Goods Tool

Discussion & Conclusions

- Analysis shows some clear **synergies** of innovative systems (e.g., agri-environmental management and system security), but also **trade-offs** (e.g., agri-environmental management and profitability)
- Some clear differences between high shares of monogastric or ruminant species for some spurs, but more nuanced for other spurs (e.g., animal welfare, social wellbeing)
- **Correlations within clusters** are being conducted to further explore differences and similarities among the groups

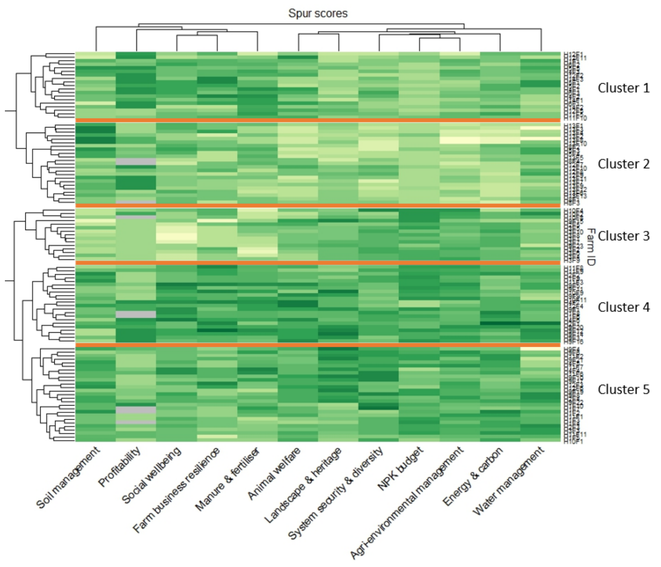

Figure 3: Heatmap of the Public Goods Tool scores per farm

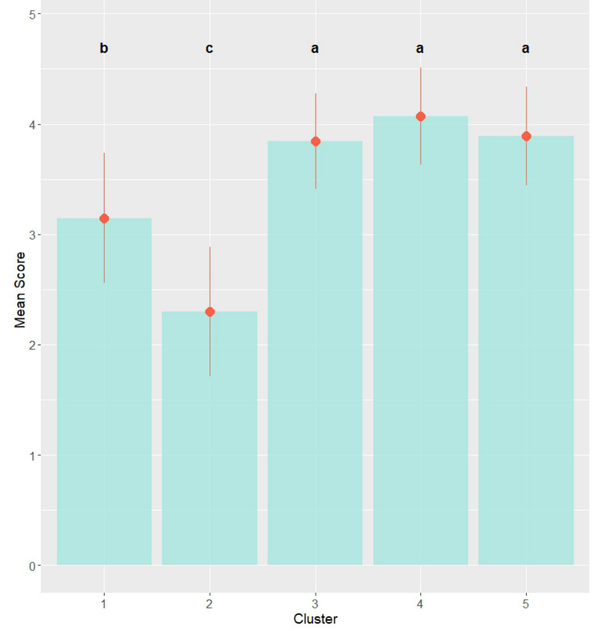

Figure 4: Kruskal Wallis test result, mean scores and standard deviation per cluster for the category "Agri-environmental management" (groups with same letters are not significantly different)

References

1. de Mendiburu, F. (2023). _agricolae: Statistical Procedures for Agricultural Research_. R package version 1.3-7.
2. Gu, Z. (2022). Complex Heatmap Visualization. iMeta.
3. Gu, Z., Eils, R. & Schlesner, M. (2016). Complex heatmaps reveal patterns and correlations in multidimensional genomic data. Bioinformatics, 32(18), 2847-9.
4. Paraskevopoulou, C., Theodoridis, A., Johnson, M., Ragkos, A., Arguile, L., Smith, L., ... & Arsenos, G. (2020). Sustainability assessment of goat and sheep farms: A comparison between european countries. Sustainability, 12(8), 3099.
5. R Core Team (2023). _R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria.

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No 101000395.