

PATHWAYS – Insights for Poster abstract "Exploring relationships among different sustainability aspects in innovative livestock systems in Europe"

Request: "comment specifically the extensive systems position within clusters, the implications for their future and the strengths and weaknesses of the generic approach to capture the multifunctionality of extensive / pastoral livestock farming. Some considerations on the relationships between multifunctionality and sustainability suggested by your survey would be very welcome."

All farming systems included in our study were initially grouped in "Practice Hubs" (PHs), national groups of farmers sharing a common innovative approach. Through the cluster analysis, farms belonging to a specific group were split among the various clusters. The extensive farming systems included in our study exhibited a wide diversity in terms of innovations and geographical distribution, belonging to six different PHs. Following a cluster analysis, these farms resulted distributed primarily in 3 clusters: n. 3, 4, and 5.

Cluster 3 was the only one composed exclusively of extensive ruminant systems and presented the smallest average farm size, compared to the other two clusters embracing such farms. Its main components were Romanian farms practicing dairy production in agroforestry systems aiming for self-sufficiency in protein-based feed, which made up over 60% of the group. Another major contribution to this group was represented by Italian farms implementing a new breeding methodology for mountain pastures with independent certification. A significant share of Italian farms of the same PH was also found in Cluster 4, in parallel to a major composition of 100% pasture-fed beef farms utilizing mob grazing, herbal leys, and mobile slaughterhouses in the United Kingdom (41% of the total), alongside with Swedish farms engaged in semi-natural grazing for nature conservation with a dedicated quality label. Farms in this cluster had the largest average farm size and performed the best overall. Finally, Cluster 5 included a substantial presence of British and Swedish farms from the same PHs as those in Cluster 4 (100% pasture-fed beef systems with mob grazing and herbal leys, and semi-natural grazing for nature conservation with a dedicated quality label). The average farm size in this cluster was intermediate between Clusters 4 and 3, while its performance scores were among the highest, albeit slightly lower than those of Cluster 4. Like Cluster 4, this cluster also included a share of monogastric farms, which may have contributed to the higher average scores, especially in the economic-related spurs.

In general, all three clusters reported high scores for most environmental-related spurs, showing that a good environmental performance in this field is possible in both small and large farms with a low stocking density, although combining the environmental ambitions with an economically and socially sustainable production seems easier in larger ones. This is further supported by the low scores reported by Cluster 3 for the economic spurs (in contrast to the higher scores of Clusters 4 and 5), reflecting not only the challenges faced by the livestock systems of this cluster, but also the broader reality of small farms leading the green transition—bearing disproportionately high transition costs to remain economically competitive. On the other hand, the multifunctionality of these extensive systems plays a crucial role in their sustainability outcomes. Based on our results, we can infer that systems that integrate diverse land-use practices (e.g., agroforestry, semi-natural grazing, and diversified production) tend to support biodiversity, carbon sequestration, and cultural landscape preservation. Given the increasing emphasis on ecosystem restoration and biodiversity enhancement under EU policies, these extensive systems are well-positioned to contribute to the restoration of degraded grassland ecosystems and the potential expansion of pasture-based livestock production in Europe. However, ensuring their long-term viability will require tailored policy incentives, improved assessment tools, and market mechanisms that recognize their broad ecosystem services beyond meat production alone, as well as the role played by a farm's size and level of specialization, as larger and more specialized extensive systems appeared better positioned to achieve both environmental and economic sustainability at scale.

In our study, the employment of a standardized methodology in this study allowed to facilitate comparisons across highly diverse farming systems, allowing for a unified assessment of extensive livestock farms alongside other production models. This approach enabled the identification of key correlations between sustainability dimensions, highlighting a general positive link between economic and social sustainability,

contrary to a more negative one between environmental and economic sustainability, while providing a broad understanding of how different management strategies can influence multiple sustainability aspects. However, a major weakness of this method was its limited capacity to capture causal relationships, particularly in such systems, where multifunctionality and context-specific factors play a crucial role. For instance, as some farms exhibited strong correlations between the spurs Profitability and Soil management, this was partly due to permanent grassland farms marking several soil-related questions as “non-applicable,” leading to extreme values and less reliable correlations. Similarly, the Water management spur was based on a limited number of questions, often challenging to answer in extensive systems, reducing the robustness of related findings. Another limitation could be attributed to the mix of quantitative and qualitative data used for scoring, as subjective perceptions and regional variations in baseline statistics may have influenced the interpretation of results. Additionally, some correlations may have been driven by a third, unmeasured factor, such as an innate openness to innovation, which was likely high among the farms studied. These challenges highlight the need for adapted assessment tools that better reflect the realities of extensive livestock systems, ensuring that key sustainability aspects—such as landscape conservation, biodiversity, and ecosystem services—are accurately represented and interpreted.