Assessing the agroecological performance of smallholder households in Kiambu and Makueni counties in Kenya

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1. INTRODUCTION

- Studies assessing agroecological performance in Kenya remain scarce.
- Farmer typologies provide a useful lens to understand the diversity of farming systems and farmers' positioning along agroecological transition levels.
- Such insights are essential for designing and scaling context-specific agroecological innovations.

Objective: To characterize smallholder farmers in two Kenyan counties and assess their agroecological transition and performance.

2. MATERIALS AND METHODS

- 479 farmers were purposively selected to represent diverse smallholder farming systems in Kiambu and Makueni counties (Nyawira et al., 2024).
- Farm-level data were collected using the *Holistic Localized Performance Assessment (HOLPA)*, covering context, agroecology, and performance dimensions (social, economic, environmental, agronomic) (Jones et al., under review).
- Scores were generated for 13 principles of agroecology based on the data.
- Cluster analysis was conducted to develop a farm typology using indicators such as land size, livestock, crop types, labor, and income, applying *Factor Analysis of Mixed Data (FAMD)* and hierarchical clustering.

3. RESULTS

The cluster analysis revealed five distinct groups of farmers (Table 1, Figure 1), which differed in crop area, income levels, livestock numbers, dominant crops, and county location. Most farmers were concentrated in the resource-constrained clusters, particularly the medium-income cluster (Cluster 1) in Kiambu and the low-income cluster (Cluster 3) in Makueni. In contrast, fewer farmers were found in the resource-endowed clusters, including the medium-income cluster (Cluster 2) in Makueni and the high-income clusters (Clusters 4 and 5) in Kiambu and both counties, respectively. The location of households emerged as a key factor driving these differences, together with other important variables such as agroecological zone, crop and livestock income, area under vegetables, and number of dairy cattle.

Table 1: Main farm characteristics of the five clusters

Main characteristics	Cluster 1 "Resource-constrained, medium-income (Kiambu)"	Cluster 2 "Resource-endowed, medium-income (Makueni)"	Cluster 3 "Resource-constrained, low-income (Makueni)"	Cluster 4 "Resource-endowed, high-income (Kiambu)"	Cluster 5 "Resource-endowed, high-income (Kiambu & Makueni)"
No. of farmers	118	98	125	109	29
Crop Area	1.1±0.9	4.1±2.3	1.8±2.3	1.3±1.3	3.2±2.7
Livestock Area	0.1±0.2	1.2±2.1	0.4±0.7	0.1±0.1	0.3±0.6
Dominant Crops	Cereals, legumes, tubers, and vegetables	Cereals, legumes, and fruits	Cereals, legumes and fruits	Cereals, legumes, tubers, vegetables, and fruits	Cereals, legumes, tubers, vegetables, and fruits
Animal husbandry	Dairy cattle =1, Poultry = 30, Ruminants=2	Dairy cattle =4, Poultry =52, Ruminants =4	Dairy cattle =2, Poultry = 27, and Ruminants = 3	Dairy cattle = 3, Poultry = 57, and Ruminants = 1	Dairy cattle = 2, Poultry = 377, Ruminants =3
Crop income (USD)	173.2	439.7	165.1	884.7	312
Livestock income (USD)	739.3	442.0	100.8	238.6	292.2

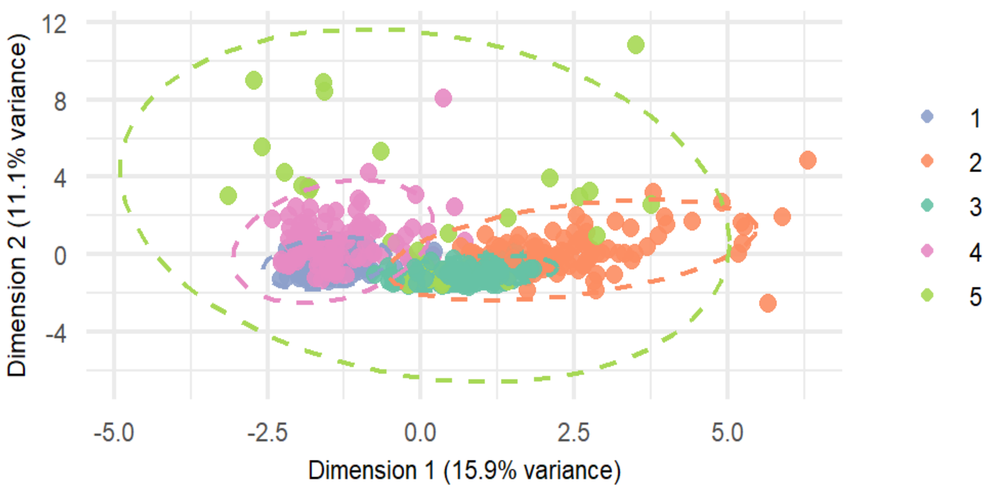

Fig. 2: Cluster plot of farmers based on the first two dimensions of the FAMD analysis.

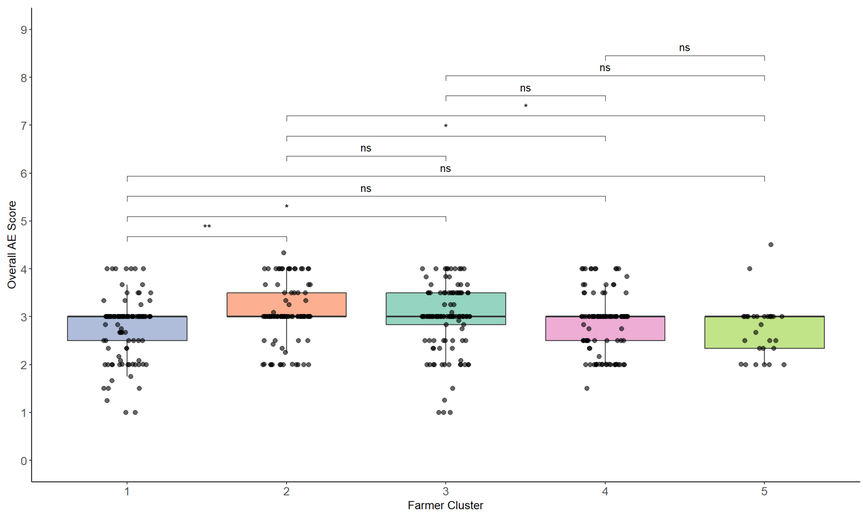

*Fig. 4: Overall agroecology (AE) scores across five farmer clusters. Boxplots show the distribution of AE scores per cluster, individual points represent farm-level scores, and pairwise significance between clusters is indicated (*p < 0.05, **p < 0.01, *p < 0.001).*

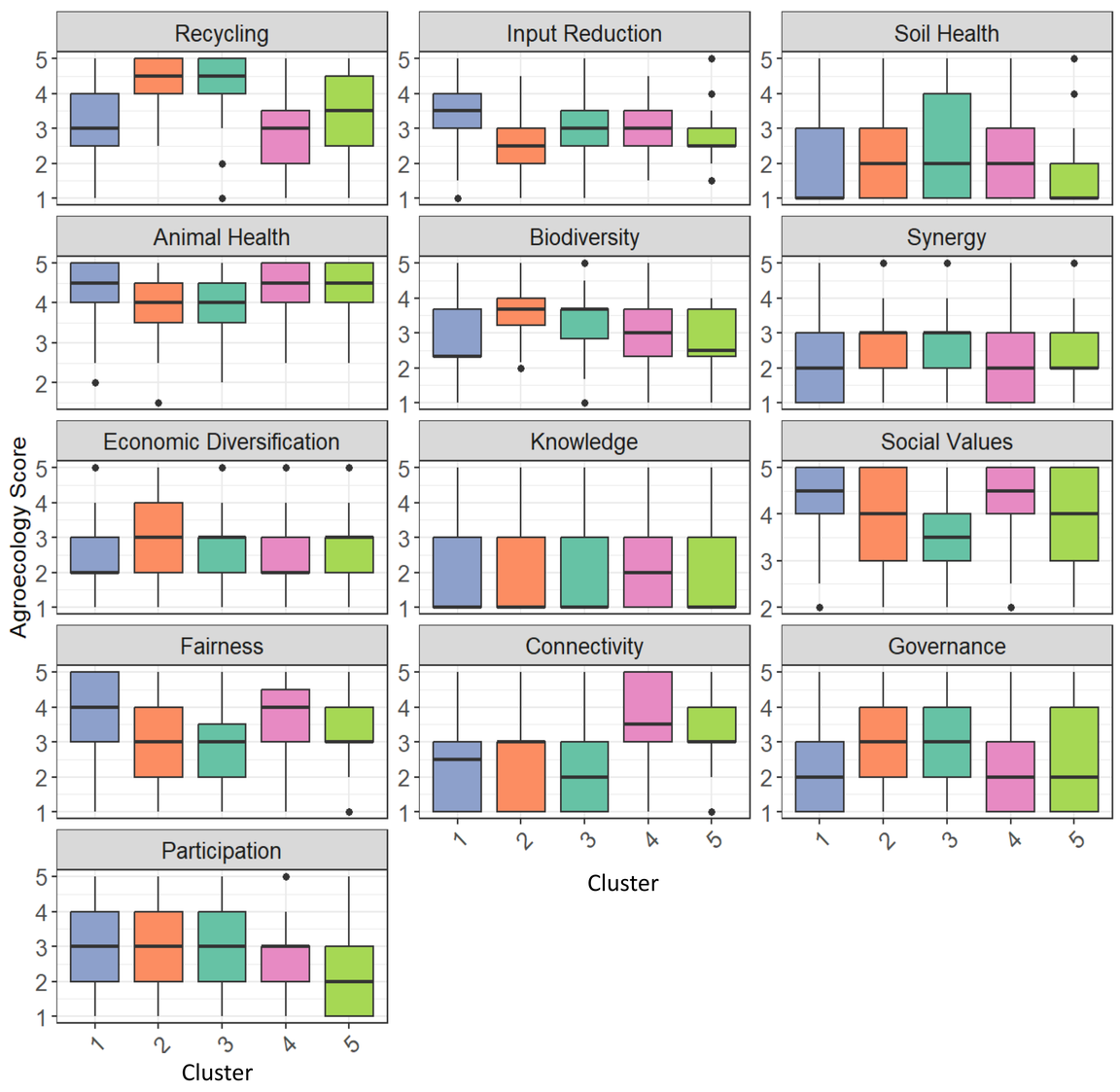

Fig. 3:Distribution of scores for the 13 agroecology principles across clusters, showing differences in performance among clusters

The analysis revealed differences in agroecology scores for the 13 principles across clusters (Figure 2). Farmers in Makueni (Cluster 2, medium-income, resource-endowed) scored higher on recycling and biodiversity, while Kiambu's livestock-rich Cluster 4 (high-income, resource-endowed) performed best on animal health. Clusters 1 (Kiambu, medium-income, resource-constrained) and 3 (Makueni, low-income, resource-constrained) consistently scored lower across several principles. Significant differences were found in eight of 13 principles—recycling, input reduction, animal health, biodiversity, connectivity, fairness, governance, and social values—while participation and knowledge showed no differences. Soil health differed between Clusters 1 and 3, and economic diversification between Clusters 1 and 2. Overall AE scores were significantly different only between Clusters 1 & 2, 1 & 3, and 2 & 4 (Figure 3).

4. CONCLUSIONS

- Farmers' agroecological practices vary across clusters, reflecting differences in resources, farming systems, and local contexts.
- Scores on the agroecology knowledge principle were generally low across clusters, highlighting the need for targeted support and capacity building.
- Targeted support and practices should be designed based on farmer characteristics and their stage of agroecological transition to enhance adoption

REFERENCES:
1. Jones et al, under review. Collecting holistic evidence on agroecology performance to accelerate sustainable food system transitions
2. Nyawira et al 2024. Performance assessment of agroecology in Makueni and Kiambu counties https://hdl.handle.net/10568/169052

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