Supplementary Material

Table S1. Variance explained by principal components

Component	Eigenvalue	Variance (%)	Cumulative Variance (%)
PC1	3.124	34.71	34.71
PC2	1.886	20.95	55.66
PC3	1.172	13.02	68.68
PC4	1.007	11.19	79.87
PC5	0.778	8.64	88.51

Notes: Generated using R 4.4.1 with the stats package (prcomp() function) for Principal Component Analysis (PCA).

Table S2. Loadings of variables on the first three principal components

Variable	PC1	PC2	PC3
Subtropical Fruits (%)	-0.900	-0.272	-0.131
Labour Density	-0.741	0.376	-0.181
Permanent Pastures (%)	0.647	-0.597	-0.206
UAA per Farm	0.642	-0.654	0.100
Shannon Diversity Index	0.639	0.588	-0.016
Potato (%)	0.547	0.303	-0.312
Vegetables (%)	0.312	0.580	0.044
Vineyard (%)	0.284	0.301	0.569
Agricultural Land (%)	-0.220	-0.147	0.804

Notes: Generated using R 4.4.1. Principal Component Analysis (PCA) was performed using the prcomp() function with scaled variables, and the loadings for the first three principal components are reported.

Table S3. K-means cluster distribution and balance for different K values

K	Cluster Distribution	Balance
3*	12, 7, 35	0.200
4	12, 5, 17, 20	0.250
5	12, 17, 5, 11, 9	0.294

Notes: Generated using R 4.4.1 with the stats package for K-means clustering; balance calculated as the ratio of the smallest to the largest cluster.

Table S4. Cluster of parishes - PAM

Cluster 1 (Intensive Subtropical Agriculture) (13 parishes -24.1%)
Arco da Calheta (Calheta); Jardim do Mar (Calheta); Paul do Mar (Calheta); Madalena do Mar (Ponta do Sol); Ponta do Sol (Ponta do Sol); Câmara de Lobos (Câmara de Lobos); Imaculado Coração de Maria (Funchal); Santa Luzia (Funchal); Santo António (Funchal); São Martinho (Funchal); São Pedro (Funchal); Sé (Funchal); Tabua (Ribeira Brava).
Cluster 2

(Extensive Traditional Agriculture) (35 parishes – 64.8%)
Calheta (Calheta); Estreito da Calheta (Calheta); Fajã da Ovelha (Calheta); Curral das Freiras (Câmara de Lobos); Estreito de Câmara de Lobos (Câmara de Lobos); Jardim da Serra (Câmara de Lobos); Quinta Grande (Câmara de Lobos); Santa Maria Maior (Funchal); São Gonçalo (Funchal); São Roque (Funchal); Água de Pena (Machico); Caniçal (Machico); Machico (Machico); Porto da Cruz (Machico); Santo António da Serra (Machico); Canhas (Ponta do Sol); Arco de São Jorge (Santana); Faial (Santana); Santana (Santana); São Jorge (Santana); São Roque do Faial (Santana); Boa Ventura (São Vicente); Ponta Delgada (São Vicente); São Vicente (São Vicente); Campanário (Ribeira Brava); Ribeira Brava (Ribeira Brava); Serra de Água (Ribeira Brava); Camacha (Santa Cruz); Caniço (Santa Cruz); Gaula (Santa Cruz); Santa Cruz (Santa Cruz); Santo António da Serra (Santa Cruz); Porto Moniz (Porto Moniz); Ribeira da Janela (Porto Moniz); Seixal (Porto Moniz).
Cluster 3
(Pasture-based Agriculture) (6 parishes – 11.1%)
Ponta do Pargo (Calheta); Prazeres (Calheta); Achadas da Cruz (Porto Moniz); Ilha (Santana); Monte (Funchal); Porto Santo (Porto Santo).
Notes: Generated using R 4.4.1 and the cluster package (Partitioning Around Medoids – PAM method).

Table S5. Parish distribution across agricultural cluster types

Cluster Name	Number of Parishes	Percentage (%)
Extensive Traditional Agriculture	35	64.8
Subtropical Intensive Agriculture	13	24.1
Pasture-based Agriculture	6	11.1

Notes: Generated using R 4.4.1 with the dplyr package, based on the results of cluster assignments from the Partitioning Around Medoids (PAM) method using the pam() function.

Table S6. Overview of agricultural cluster characteristics

Variable	**Cluster 1** Intensive Subtropical Agriculture (13 parishes, 24.1%)	**Cluster 2** Extensive Traditional Agriculture (35 parishes – 64.8%)	**Cluster 3** Pasture-based Agriculture (6 parishes – 11.1%)
Number of Parishes	13	35	6
Percentage of Total (%)	24.1	64.8	11.1
Average UAA (ha)	0.25	0.35	0.86
Average Labour Density	1.1	0.8	0.4
Average Diversity Index	0.942	1.52	1.37
Average Agricultural Land (%)	11.8	9.88	5.23
Subtropical Fruits (%)	72.2	15.1	5.0
Vineyard (%)	5.4	18.3	8.3
Vegetables (%)	6.0	20.1	9.9
Potato (%)	2.2	7.1	6.8
Permanent Pastures (%)	1.7	6.8	48.6
Clean Arable Land (%)	13.8	41.7	27.5

Notes: Generated using R 4.4.1 with the dplyr package, summarizing cluster-level agricultural characteristics.

Table S7. Predominant crops by cluster

Cluster	Cluster Name	Dominant Crop	n	%
1	Intensive Subtropical Agriculture	Subtropical Fruits	13	100.0
2	Extensive Traditional Agriculture	Clean Arable Land	26	74.3
2	Extensive Traditional Agriculture	Vineyard	5	14.3
2	Extensive Traditional Agriculture	Subtropical Fruits	4	11.4
3	Pasture-based Agriculture	Permanent Pastures	4	66.7
3	Pasture-based Agriculture	Clean Arable Land	2	33.3

Notes: Generated using R 4.4.1 with the dplyr package, summarizing counts and percentages of predominant crops by cluster.

Table S8. PAM cluster distribution and balance for different K values

K	Cluster Distribution	Balance
3*	13, 35, 6	0.171
4	15, 22, 11, 6	0.273
5	22, 7, 11, 4, 10	0.182

Notes: Generated using R 4.4.1 with the cluster package for Partitioning Around Medoids (PAM); balance calculated as the ratio of the smallest to the largest cluster.

Table S9. Random Forest Model summary (training data)

Item	Value
Type of Random Forest	Classification
Number of Trees	500
Variables Tried at Each Split	3
OOB Error Rate	**4.55%**

Notes: Generated using R 4.4.1 with the randomForest package, summarizing model parameters and out-of-bag (OOB) error for the training dataset.

Table S10. Confusion matrix of the Random Forest Model (training data)

Actual \ Predicted	1	2	3	Class Error
1	10	1	0	0.0909
2	0	28	0	0.0000
3	0	1	4	0.2000

Notes: Generated using R 4.4.1 with the randomForest package, showing the confusion matrix and class-wise error rates for the training dataset.

Table S11. Confusion matrix of the Random Forest Model (test data)

Prediction \ Reference	1	2	3
1	2	0	0
2	0	7	1
3	0	0	0

Notes: Generated using R 4.4.1 with the randomForest package, showing the confusion matrix for the test dataset.

Table S12. Overall performance statistics of the Random Forest Model (test data)

Metric	Value
Accuracy	0.90
95% CI	(0.555, 0.9975)
No Information Rate (NIR)	0.70
P-value [Acc > NIR]	0.1493
Kappa	0.75
Mcnemar's Test P-value	NA

Notes: Generated using R 4.4.1 with the caret and randomForest packages, reporting overall performance metrics for the Random Forest model on the test dataset.

Table S13. Class-wise performance metrics of the Random Forest Model (test data)

Metric	**Cluster 1** Intensive Subtropical Agriculture (13 parishes, 24.1%)	**Cluster 2** Extensive Traditional Agriculture (35 parishes – 64.8%)	**Cluster 3** Pasture-based Agriculture (6 parishes – 11.1%)
Sensitivity	1.0	1.0000	0.0
Specificity	1.0	0.6667	1.0
Positive Predictive Value	1.0	0.8750	NaN
Negative Predictive Value	1.0	1.0000	0.9
Prevalence	0.2	0.7000	0.1
Detection Rate	0.2	0.7000	0.0
Detection Prevalence	0.2	0.8000	0.0
Balanced Accuracy	1.0	0.8333	0.5

Notes: Generated using R 4.4.1 with the caret and randomForest packages, reporting class-wise performance metrics for the Random Forest model on the test dataset.

Table S14. Variable importance ranking of the Random Forest Model

Variable	Mean Decrease Accuracy	Mean Decrease Gini
Subtropical Fruits (%)	22.053478	6.5709481
Arable Land (%)	12.588584	3.4387721
Permanent Pastures (%)	10.493131	2.5270560
Shannon diversity index	9.981917	2.6908069
UAA per Farm	9.810998	2.7343333
Labour_Density	7.673856	1.4392244
Vegetables (%)	5.902105	0.9575726
Vineyard (%)	4.487863	0.7960420
Potato (%)	3.270097	0.8436073
% Agricultural Land	-1.002503	0.4040918

Notes: Generated using R 4.4.1 with the randomForest package, showing variable importance based on Mean Decrease Accuracy and Mean Decrease Gini for the classification model**.**

Table S15. Confusion matrix of the Random Forest Model (full dataset predictions)

Prediction \ Reference	**1**	**2**	**3**
1	13	0	0
2	0	35	1
3	0	0	5

Notes: Generated using R 4.4.1 with the randomForest package, presenting the confusion matrix for the Random Forest model predictions on the full dataset.

Table S16. Overall performance statistics of the Random Forest Model (full dataset predictions)

Metric	Value
Accuracy	0.9815
95% CI	(0.9011, 0.9995)
No Information Rate (NIR)	0.6481
P-Value [Acc > NIR]	2.051e-09
Kappa	0.9629
Mcnemar's Test P-value	NA

Notes: Generated using R 4.4.1 with the randomForest package, summarizing the overall performance statistics for the Random Forest model on full dataset predictions.

Table S17. Class-wise performance metrics of the Random Forest Model (full dataset predictions)

Metric	**Cluster 1** Intensive Subtropical Agriculture (13 parishes, 24.1%)	**Cluster 2** Extensive Traditional Agriculture (35 parishes – 64.8%)	**Cluster 3** Pasture-based Agriculture (6 parishes – 11.1%)
Sensitivity	1.0000	1.0000	0.83333
Specificity	1.0000	0.9474	1.00000
Positive Predictive Value	1.0000	0.9722	1.00000
Negative Predictive Value	1.0000	1.0000	0.97959
Prevalence	0.2407	0.6481	0.11111
Detection Rate	0.2407	0.6481	0.09259
Detection Prevalence	0.2407	0.6667	0.09259
Balanced Accuracy	1.0000	0.9737	0.91667

Notes: Generated using R 4.4.1 with the randomForest package, presenting class-wise performance metrics of the Random Forest model for full dataset predictions.

Table S18. Class-wise performance metrics (Cluster-level statistics)

Cluster	**Sensitivity**	**Specificity**	**Precision**	**Recall**	**F1-Score**
Cluster 1	1.000	1.000	1.000	1.000	1.000
Cluster 2	1.000	0.947	0.972	1.000	0.986
Cluster 3	0.833	1.000	1.000	0.833	0.909

Notes: Generated using R 4.4.1 with the caret and randomForest packages, reporting class-wise performance metrics (cluster-level statistics) of the Random Forest model.