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Corresponding Editor: Mario Cozzi

ORCID

TM: 0000-0001-5768-1407

TP: 0000-0001-5068-2562

GG: 0000-0003-0007-4133

AIDL: 0000-0002-8716-8177

ES: 0000-0002-3178-2143

Research article

Balancing sustainability and profitability: Italian farmers' perspectives on Common Agricultural Policy eco-schemes

**Teresina Mancuso¹, Tiziana Pagnani^{*2}, Giovanni Gulisano³, Anna Irene De Luca³, Emanuele
Spada³**

¹Department of Agricultural, Forest and Food Sciences, University of Turin, Italy

²Department of Economics and Law, University of Cassino and Southern Lazio, Italy

³Department of Agriculture, Mediterranean University of Reggio Calabria, Italy

*Corresponding author E-mail: tiziana.pagnani@unicas.it

Abstract

The 2023-2027 Common Agricultural Policy (CAP) reform introduces 'eco-schemes' as a voluntary, payment-for-practice mechanism to operationalise the European Green Deal. Despite significant financial ring-fencing, farmer uptake remains contingent upon the complex interplay between economic incentives, technical feasibility, and behavioural factors. In this context, this study investigates the drivers of eco-scheme adoption in Italy, a country characterised by high structural and regional heterogeneity. Using survey data from 345 farmers, we employ latent class analysis to identify distinct attitudinal and operational profiles. The model identifies four latent classes: 'animal welfare specialists', 'collective pragmatists', 'proactive farmers', and 'CAP sceptics'. Our findings reveal a significant 'perception inversion': while specialised livestock farmers perceive high utility in animal welfare measures, they report negligible impacts and low premium congruity for area-based

interventions, with the opposite trend observed among crop-oriented farmers. Furthermore, a critical ‘information bottleneck’, stemming from low cognitive accessibility and reliance on intermediaries, deters participation among smaller, traditional farms. The results suggest that a monolithic policy design fails to account for the diverse opportunity costs and technical constraints of heterogeneous farm typologies. In conclusion, especially in view of the post-2027 CAP, achieving desired adoption effects requires a shift from flat-rate compliance towards differentiated incentives and robust agricultural knowledge and innovation systems to mitigate the inherent uncertainty of the new ‘green architecture’.

Keywords: Common Agricultural Policy, Eco-schemes, Latent class analysis, Farmer behaviour, Sustainable agriculture, Italy.

JEL codes: L21, O13, Q18.

Highlights:

- Latent Class Analysis identifies four distinct farmer profiles toward CAP eco-schemes.
- A “perception inversion” exists between livestock and area-based green incentives.
- Small-scale farms face regressive transaction costs that hinder ecological transition.
- Personalised advisory services are vital to bypass policy bottlenecks, as informational deficits constitute a significant barrier to adoption.

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1. Introduction

The European Union’s agricultural sector stands at a critical crossroads, facing multifaceted challenges from food security to escalating climatic volatility, environmental degradation, and geopolitical uncertainties. Within this context, agriculture remains at the forefront of the policy agenda, gaining greater regulatory prominence through the Common Agricultural Policy (CAP) (De Castro *et al.*, 2020; Sotte, 2025). Since 1962, the CAP has undergone profound structural transformations to address shifting societal demands, establishing itself as the central nexus between food systems, rural development, and environmental stewardship (Del Giudice, 2024). This trajectory has progressively moved beyond a uniform, standardised approach to differentiate interventions based on the specific requirements of diverse national agricultural landscapes (Henke *et al.*, 2018).

The achievement of food security, initially pursued through self-sufficiency under Article 39 of the Treaty of Rome, has progressively shifted towards pronounced environmental objectives (Đokić *et al.*, 2022; European Commission, 2022). Over the last two decades, the CAP has pivoted towards sustainable production paradigms, incentivising eco-compatible practices and natural capital management (European Commission, 2020). However, reconciling ecosystem protection with income stability for agricultural operators remains a core challenge (Frascarelli *et al.*, 2025). The 2014-2020 programming period (European Union [EU] Reg. 1307/2013) marked a turning point by introducing ‘green payments’ (greening) within the first pillar (Cortignani *et al.*, 2017). This framework laid the groundwork for the post-2020 CAP ‘green architecture,’ where greening has been subsumed into and bolstered by ‘enhanced conditionality’ and ‘eco-schemes’ (Pierangeli *et al.*, 2023).

The post-2020 CAP, situated within the European Green Deal framework (European Commission, 2019) and operationalised in Regulation (EU) 2021/2115, aims to position Europe as the first climate-neutral continent by 2050. These strategies set ambitious 2030 targets, including a reduction in fertiliser (-20%), pesticide (-50%), and antimicrobial (-50%) use, while expanding organic farming to 25% of the total utilised agricultural area (UAA) (European Commission, 2020). Notwithstanding the potential of agri-environmental schemes to enhance biodiversity, farmer uptake frequently falls short of expectations (Dessart *et al.*, 2019; Hasler *et al.*, 2022). Therefore, it is essential to elucidate the behavioural factors influencing farmers' decision-making processes regarding these new instruments.

Eco-schemes constitute a pivotal element of the 2023-2027 CAP reform; enforced by a strict 25% financial ring-fencing of first pillar resources, this instrument substantially raises the baseline environmental standards required to qualify for agricultural support. However, the success of this ambitious framework remains constrained by historical implementation challenges. Although adaptive capacity and flexibility were programmatic aspirations since the CAP's inception (De Castro *et al.*, 2013), the EU has frequently encountered operational difficulties in translating these ambitions into tangible outcomes. The literature highlights a persistent decoupling between strategic planning and implementation realities (Daugbjerg, Swinbank, 2016; Hepping *et al.*, 2025; Kay, 2003) primarily driven by bureaucratic complexity and rigid eligibility criteria that constrain the innovative potential of eco-schemes. Consequently, rather than fostering a flexible transition, the technical-administrative apparatus remains susceptible to path dependency and regulatory layering (Greer, 2017; Hepping *et al.*, 2025; Pokrivcak *et al.*, 2006), which reinforces institutional inertia and occasionally preserves legacy production models under updated formal labels.

Given this context, the primary objective of this study is to investigate Italian farmers' perceptions of the 2023-2027 CAP commitments, with a specific focus on the adoption and feasibility of eco-schemes. This study explores farmers' knowledge, willingness to adopt, evaluations of incentive adequacy, and the perceived impact on profitability and sustainability. It employs latent class analysis (LCA) integrated with the theory of planned behaviour (TPB) to identify distinct attitudinal and operational profiles among the farming population.

To the best of the authors' knowledge, this is the first study to analyse eco-scheme implementation in Italy using primary survey data. While recent research has examined the Netherlands (de Sonaville *et al.*, 2025) and Poland (Zieliński *et al.*, 2024), the Italian case, characterised by significant structural and regional heterogeneity, remains largely unexplored.

Understanding these dynamics is critical for assessing policy feasibility and refining the design of future agri-environmental interventions.

2. EU objectives and the Italian context

Eco-schemes align domestic agricultural policy with international commitments like the Paris Agreement, the 2030 United Nations (UN) Agenda, and the European Green Deal, marking a decisive departure from the previous ‘greening’ mechanism. Financed entirely by the EU budget without requiring national co-funding, these instruments grant significant operational flexibility to member states under Article 31 of Regulation (EU) 2021/2115. While the annual nature of these commitments lowers entry barriers for producers, it could compromise long-term business planning security and conflict with the multi-annual horizon required to achieve tangible ecological outcomes (Lampkin *et al.*, 2020). This architecture introduces systemic risks, including the inability to roll over unspent European Agricultural Guarantee Fund (EAGF) resources and a potential ‘race to the bottom’ regarding member state ambition. Specifically for the organic sector, it creates challenges involving double-funding risks and bureaucracy with pre-existing second pillar agri-environment-climate measures (AECMs). While sharing a voluntary nature with the second pillar’s AECMs, there is a fundamental legal distinction: eco-scheme payments constitute a statutory right for all eligible farmers, whereas second pillar measures remain subject to competitive tenders.

At the national level, the transposition of this European framework, governed by Regulations (EU) 2021/2115 and 2021/2116, culminated in the formal approval of the Italian CAP Strategic Plan (PSP) via Commission Implementing Decision C (2022) 8645 final. Technical specifications and eligibility criteria for the five national eco-schemes were codified under the Ministry of Agriculture Food Sovereignty and Forestry *(Ministero dell'agricoltura, della sovranità alimentare e delle foreste)* (MASAF) Decree No. 660087/2022, while the enforcement and penalty framework was established by Legislative Decree No. 42/2023, making premiums fully enforceable within the single application through implementing circulars from the Italian National Agency for Agricultural Payments *(Agenzia per le erogazioni in agricoltura)* (AGEA) and the regional agencies.

Strategically, Italy allocated €4.37 billion to five specific eco-schemes (2023-2027) to target key territorial vulnerabilities (Figure 1). Eco-scheme 1 (livestock) received the largest share, accounting for 41.5% of total resources, while the remaining budget was distributed among eco-scheme 4 (extensive forage, 19%), eco-scheme 2 (permanent crops, 18%), eco-scheme 3 (olive groves, 17%), and eco-scheme 5 (pollinators, 5%). Monitoring of the first implementation year (2023) reveals geographic dualism: eco-scheme 1 localised in the North (66%) and area-based schemes (2-5) in the South (56%) (Rete PAC, 2024). Remarkably, national adoption reached 141% of the target, driven by eco-scheme 4 (222%). Although high participation signals success, this over-claiming against a fixed budget effectively halved the unit premium, specifically for eco-scheme 4 (AGEA, 2024). This phenomenon is central to our study, providing an empirical basis for investigating farmers’ perceptions of incentive adequacy and the inherent uncertainty of the new payment mechanism.

THE 5 ECO-SCHEMES OF THE CAP 2023-2027					
					
Eco-Scheme Name	1. Reduction of antimicrobial resistance and animal welfare	2. Green cover on permanent crops	3. Protection of olive groves of high landscape and historical value	4. Extensive forage systems with crop rotation	5. Specific measures for pollinators
Objective	Mitigate AMR risks via reduced veterinary medicine usage and promote extensive grazing systems to enhance ethological animal welfare	Prevent mechanical soil erosion, enhance organic carbon sequestration, and minimize chemical inputs in woody crops	Counteract land abandonment in marginal areas and preserve historical agricultural landscapes and agro-ecosystem heritage	Optimize soil structural biodiversity, enhance natural nitrogen fixation, and mitigate the carbon footprint of arable systems	Safeguard trophic networks and restore habitats for wild and managed pollinators
Eligible Area / Target	Action 1: Livestock AMR reduction; Action 2: SQNBA certification + open-air grazing	National utilized agricultural area under permanent crops	Traditional low-density olive groves (< 400trees/ha)	Total national arable land surfaces	Arable land plots or permanent crop inter-rows
Commitments	Comply with national/regional antibiotic thresholds; adhere to mandatory grazing calendars	Maintain >70% inter-row herbaceous cover (Sep 15 - May 15). Absolute ban on chemical weeding and tillage within inter-rows	Mandatory biennial canopy pruning. Total ban on the on-site burning of agricultural residues and conversion to intensive systems	Execute a minimum biennial crop rotation. Integrate leguminous or soil-improving crops. Absolute ban on herbicides on crop mixtures	Establish/maintain specific melliferous plant associations. Total ban on mowing/shredding during flowering (Mar 1 - Sep 30)
Financial Support	Dairy: €66/LU; Grazing: €240-€300/LU	€120/ha (+20% in Natura 2000/NVZ)	€220/ha (+20% in Natura 2000/NVZ)	€110/ha (+20% in Natura 2000/NVZ)	Arable land: €250/ha; Permanent crops: €500/ha

Figure 1. Operational framework and commitments of the 2023-2027 Common Agricultural Policy (CAP) eco-schemes.

3. Materials and Methods

3.1. Theoretical framework

Beyond the standard neoclassical focus on opportunity costs, this study integrates the TPB (Ajzen, 1991) to account for the non-pecuniary factors shaping farmers' transition towards environmentally sustainable practices. The TPB explains behavioural intentions through three psychological constructs: attitudes, subjective norms, and perceived behavioural control (Bond *et al.*, 2009; Brodt *et al.*, 2004; Veisi, 2012). It assumes that intention is considered a reliable predictor of actual behaviour, influenced by individuals' evaluations of the behaviour, social pressure, and perceived capacity (Ajzen, 1991). Within agriculture, the TPB has been extensively applied to investigate management choices (Despotović *et al.*, 2019; Wauters *et al.*, 2010, Ajzen, 2020). The framework is adopted in this study for three reasons: it offers strong explanatory power for decision-making (Fielding *et al.*, 2008); it distinguishes internal psychological drivers from external contextual constraints (Wauters *et al.*, 2010), such as budgetary volatility; and it is highly effective in agri-environmental research examining sustainable uptake (Meijer *et al.*, 2015; van Dijk *et al.*, 2016).

3.2. Data collection and survey design

A structured online questionnaire was administered to Italian farmers between March and May 2025, yielding 345 valid responses. Data collection targeted two distinct regions to capture structural heterogeneity: Piedmont (North-West Italy), characterised by larger, capital-intensive, and market-integrated farms; and Calabria (South Italy), featuring a fragmented structure with smaller

farms, permanent crops, and higher organic farming prevalence. These regions were selected to capture substantial heterogeneity in farming systems, socio-economic conditions, and regional policy implementation, thereby allowing the analysis to explore structurally differentiated agricultural contexts within Italy. Piedmont and Calabria were selected by considering methodological rigour and theoretical contrast. The two regions embody markedly divergent agricultural configurations and can therefore be understood as contrastive strata within a purposive sampling design. Their differences in farm structure, production models, market integration, and socio-institutional conditions increase between-context variance and enhance the capacity to identify systematic patterns in farmers decision-making processes. By capturing the opposite ends of key structural gradients within Italian agriculture, the research design improves analytical leverage and reduces the risk of context-specific bias. However, this strategy does not imply statistical representativeness at the national level. Rather, the selection strengthens the study's analytical and theoretical generalisability, allowing the identified behavioural mechanisms to be interpreted as potentially relevant for structurally analogous agricultural contexts across the country.

The questionnaire was organised into two thematic modules. The first module elicited general perceptions regarding the CAP and the adequacy of public support. The second module focused specifically on 'green architecture', evaluating the status of its adoption across the five national eco-schemes and the perceived congruity of the premiums. For the latter, respondents evaluated the adequacy of the payments relative to the operational commitments on a 6-point Likert scale, ranging from 0 ('no knowledge/cannot evaluate') to 5 ('completely congruent'). To minimise information asymmetry and ensure informed evaluations, participants were provided with the actual budgetary ranges for each measure.

The questionnaire also captured the perceived impacts of each scheme on three fundamental dimensions – farm profitability, productivity, and environmental sustainability – each rated using a similar 5-point Likert scale. Beyond these scheme-specific indicators, broader psychological and institutional constructs were elicited, specifically the perceived adequacy of public support for long-term farm planning and the degree of societal recognition attributed to the farming profession.

Finally, comprehensive farm-level data were collected, including UAA; the presence of livestock; farming system; marketing channels; annual net farm income brackets; and socio-demographic indicators such as the farmers age and the number of generations involved.

3.3. Statistical analysis and latent class model

LCA was performed to identify distinct groups of farmers with similar perceptions and farm characteristics (Goodman, 1974; Lanza *et al.*, 2003). Unlike traditional continuous latent framework models like structural equation modelling (SEM), which typically assume multivariate normality and continuous constructs, LCA is a discrete, typology-seeking approach specifically tailored to handle categorical and ordinal survey data without structural linearity constraints (Collins, Lanza, 2010). This methodology directly models multi-dimensional response patterns to detect latent groups and segment the population into distinct behavioural profiles. The model included multiple items related to the perceived congruity and impact of eco-schemes, as well as broader perceptions of public support and recognition of the agricultural profession (Figure 2). Furthermore, to account for regional differences in farmers' responses, the variable 'region' was included as a covariate in the LCA model.

This approach allowed for the effect of the regional context on class membership probabilities to be estimated while preserving the probabilistic clustering of attitudinal profiles. Although regional differences were evident in class membership, a region-specific LCA was not conducted due to a significant sample imbalance between the two areas (Piedmont: 77.4%, Calabria: 22.6%). A stratified LCA would have resulted in unreliable estimates for Calabria due to the limited sample size. Therefore, a unified model was adopted, with ‘region’ included as a covariate to account for territorial heterogeneity while maintaining model stability and interpretability.

The analysis estimated the latent classes and the structural effect of covariates simultaneously within a single maximum likelihood framework. The optimal number of classes was determined using the Akaike information criterion (AIC) and the Bayesian information criterion (BIC), while model stability was assessed using multiple random starting values to ensure global convergence. Based on the lowest BIC value, a four-class model was chosen. This solution exhibited robust class separation and meaningful interpretability, with estimated class population shares ranging from approximately 11% to 35%.

Once the optimal latent class solution was identified, individual posterior probabilities of class membership were extracted for each farmer. To profile the segments against external structural and socio-demographic variables not included as covariates in the LCA loop, observations were assigned to empirical clusters using a modal assignment strategy. This standard econometric procedure ensures explicit correspondence between theoretical latent classes and empirical clusters. The statistical analysis was conducted using R.(version 4.3.0).

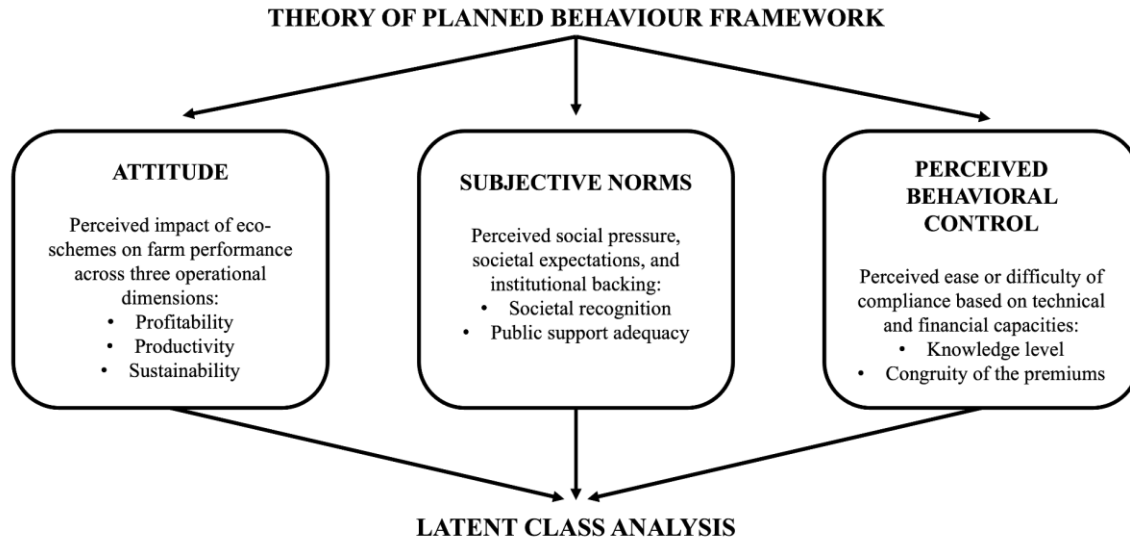


Figure 2. Conceptual operationalisation of the theory of planned behaviour constructs.

4. Results

The LCA identified four distinct classes of farmers based on their attitudinal profiles and TPB dimensions. To bridge the gap between the probabilistic nature of the estimated latent classes and the empirical profiling of the groups, farmers were formally assigned to four definitive empirical clusters. This matching was operationalised by applying the standard modal assignment rule, whereby each

observation is mapped into a specific cluster based on its highest posterior probability of class membership (i.e., cluster 1 strictly corresponds to latent class 1, cluster 2 to latent class 2, and so forth). Following this formal assignment, cluster 4 represents the largest empirical segment (35.07%), followed by cluster 3 (33.33%), cluster 2 (20.29%), and cluster 1 (11.30%). The following subsections detail the structural and statistical differences across these empirical clusters.

4.1. Analysis of socio-demographic and farm characteristics

The descriptive analysis of the aggregate sample (Table A.1) depicts a mature farming population, with 51.3% of respondents aged 45-64 years. A robust intergenerational continuity is evident, with 64.06% of holdings involving more than two generations. Conventional farming remains the dominant system (56.23%), and land structures are notably fragmented, with 44.35% of farms falling within the 10-50 hectare UAA range. Structurally, crop cultivation is ubiquitous, covering 97.10% of the sample, while livestock integration characterises 34.78% of the surveyed farms.

The LCA reveals significant structural divergence across the four clusters. There is a highly significant regional effect ($\chi^2 = 75.28$, $p < 0.001$): cluster 1 is almost exclusively composed of Piedmontese farmers (97.44%), whereas cluster 3 exhibits the highest territorial balance, split nearly equally between Piedmont (51%) and Calabria (49%). Age distribution is also a significant discriminator ($\chi^2 = 30.96$, $p < 0.001$), with cluster 2 representing the most ‘youth-oriented’ segment (45.85% under 44 years), while clusters 3 and 4 lean towards more mature age brackets.

Regarding operational characteristics, farm technical orientation is an important driver, showing a significant effect for livestock integration ($\chi^2 = 45.30$, $p < 0.001$) due to its concentration in cluster 1 (69.23%), while crop cultivation remains ubiquitously distributed across 97.10% of the sample ($\chi^2 = 1.49$, $p > 0.10$). UAA is also a critical factor ($\chi^2 = 34.18$, $p < 0.001$); cluster 1 is characterised by larger holdings (>50 ha), while cluster 4 is dominated by small-scale farms. Farming systems also vary significantly ($\chi^2 = 26.63$, $p < 0.001$): cluster 3 reports the highest prevalence of integrated (33.91%) and organic (44.35%) systems, whereas clusters 1 and 4 remain predominantly conventional. Interestingly, annual net farm income does not differ significantly across clusters ($\chi^2 = 6.73$, $p > 0.10$), suggesting that attitudinal segmentation is driven by structural and behavioural factors rather than immediate economic performance alone.

4.2. Perceived institutional support and professional recognition

The perceived adequacy of public support varies significantly among the clusters ($\chi^2 = 16.30$, $p = 0.001$; Table A.2). Satisfaction is highest for **clusters 1 and 3** (mean = 2.41 and 2.33, respectively), while there is significantly lower confidence in subsidy adequacy for **cluster 2** (mean = 1.90). Conversely, the perceived societal recognition of the agricultural role is relatively homogeneity across the sample ($p = 0.085$), with post hoc Dunn tests failing to identify significant pairwise differences, indicating a shared, moderately low perception of professional status across all groups.

4.3. Knowledge and adoption of eco-schemes

Awareness and uptake patterns reveal a deeply segmented landscape (Table 1). At the aggregate level, knowledge of eco-scheme 1 (55.07%) is lower than that of the area-based cluster (eco-schemes

2-5, 66.96%). Regional disparities are stark: eco-scheme 1 adoption is heavily concentrated in Piedmont, while eco-scheme 3 is almost exclusively a Calabrian phenomenon (Figure 3).

Table 1. Adoption and knowledge of eco-schemes.

	Sample		Cluster 1: animal welfare specialists		Cluster 2: collective pragmatists		Cluster 3: proactive farmers		Cluster 4: CAP sceptics		Chi-square test	
	Freq	%	Freq	%	Freq	%	Freq	%				
Adoption												
Eco-scheme 1	71	20.58	25	64.10	7	10.00	34	29.57	5	4.13	75.70	***
Eco-scheme 2	88	25.51	3	7.69	23	32.86	45	39.13	17	14.05	28.10	***
Eco-scheme 3	63	18.26	1	2.56	16	22.86	38	33.04	8	6.61	32.27	***
Eco-scheme 4	57	16.52	4	10.26	13	18.57	34	29.57	6	4.96	27.24	***
Eco-scheme 5	39	11.30	2	5.13	4	5.71	24	20.87	9	7.44	15.96	***
Knowledge												
Eco-scheme 1	190	55.07	39	100.00	15	21.43	115	100.00	21	17.36	227.22	***
Eco-schemes 2-5	231	66.96	18	46.15	70	100.00	115	100.00	28	23.14	203.92	***

Note: CAP = Common Agricultural Policy; Freq = frequency. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$

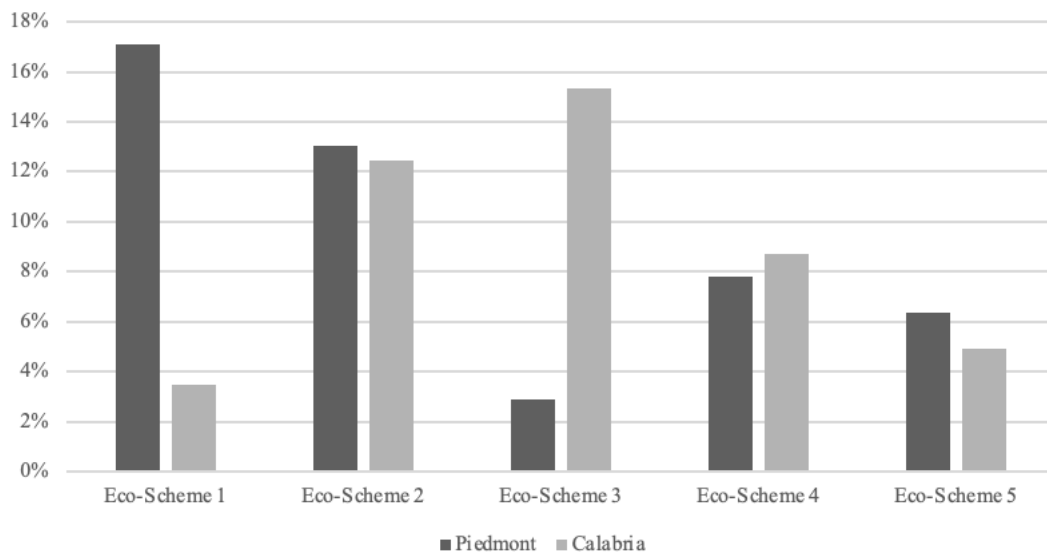


Figure 3. Adoption rates of the five eco-schemes broken down by region

The LCA highlights a profound alignment between knowledge and adoption. There is universal awareness (100%) of eco-scheme 1 in clusters 1 and 3, whereas clusters 2 and 4 remain largely uninformed (knowledge rates $< 22\%$). Adoption of eco-scheme 1 is highly polarised, with cluster 1 leading (64.10%) and cluster 4 showing minimal uptake (4.13%). For eco-schemes 2-5, cluster 3 represents the ‘proactive’ leader, with the highest adoption rates across all measures (e.g., 39.13% for eco-scheme 2 and 29.57% for eco-scheme 4). These findings reinforce the premise that ‘those who do not know, do not adopt’, underscoring information as a primary barrier to entry.

4.4. The ‘perception inversion’: impacts and premium congruity

The aggregate perceptions of eco-scheme impacts are generally modest, with mean scores rarely exceeding 2.10 (Table 2). Environmental sustainability is perceived more favourably than profitability or productivity impacts. However, this mean masks a critical ‘perception inversion’ between clusters ($p < 0.001$).

Clusters 1 and 3 perceive substantial benefits from eco-scheme 1 across all dimensions (profitability, productivity, and sustainability). However, for area-based measures (eco-schemes 2-5), cluster 1 perception is near-zero, while clusters 2 and 3 report high positive values. This diametric opposition, where cluster 1 values livestock-based measures and cluster 2 values land-based ones, suggests that farmers’ attitudes are not just a reflection of general ‘greenness’; they are strictly tied to the intrinsic design of the scheme and its fit with the farms existing production system.

Regarding premium congruity, cluster 3 consistently assigns the highest scores, perceiving the incentives as most aligned with their practices. Cluster 4 remains systematically sceptical, reporting the lowest congruity ratings across all schemes. For cluster 1, congruity is high for eco-scheme 1 (1.77) but highly variable for the others. This suggests that while proactive farmers (cluster 3) find the current ‘green architecture’ acceptable, the ‘sceptics’ (cluster 4) perceive a fundamental misalignment between the required ecological commitment and the financial compensation.

Table 2. Perceived impact and adequacy of eco-schemes.

	Sample		Cluster 1: animal welfare specialists		Cluster 2: collective pragmatists		Cluster 3: proactive farmers		Cluster 4: CAP sceptics		Kruskal- Wallis test	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
Impact on profitability												
Eco-scheme 1	1.13	1.55	2.51	1.62	0.06	0.48	2.50	1.26	0.00	0.00	279.57	***
				ac		b		a		bc		
Eco-schemes 2-5	1.22	1.44	0.00	0.00	2.10	1.30	2.40	1.44	0.00	0.00	279.84	***
				ac		b		b		bc		
Impact on productivity												
Eco-scheme 1	1.11	1.52	2.38	1.50	0.01	0.12	2.51	1.26	0.00	0.00	287.09	***
				ac		b		a		bc		
Eco-schemes 2-5	1.20	1.45	0.00	0.00	2.24	1.31	2.23	1.24	0.01	0.09	276.68	***
				ac		b		b		bc		
Impact on sustainability												
Eco-scheme 1	1.32	1.71	2.95	1.47	0.00	0.00	2.97	1.25	0.00	0.00	308.76	***
				ac		b		a		bc		
Eco-schemes 2-5	1.56	1.69	0.23	0.81	2.63	1.31	2.83	1.35	0.17	0.76	241.01	***
				ac		b		b		bc		
Adequacy of payment												
Eco-scheme 1	1.06	1.28	1.77	1.16	0.34	0.72	2.17	1.15	0.19	0.57	185.37	***
				ab		a		b		ac		
Eco-scheme 2	1.08	1.11	0.87	0.20	1.33	1.07	1.47	1.10	0.64	0.96	47.60	***
				ab		bc		b		ac		
Eco-scheme 3	1.76	1.38	1.72	1.57	1.67	1.28	2.20	1.24	1.40	1.39	21.85	***
				abc		ac		b		a		
Eco-scheme 4	1.79	1.26	2.00	1.43	1.74	1.14	2.04	1.19	1.52	1.27	11.46	***
				abc		abc		a		b		

Eco-scheme 5	2.10	1.47	2.10	1.73	2.03	1.31	2.67	1.28	1.60	1.46	32.81	***
			<i>ac</i>			<i>ac</i>		<i>b</i>		<i>a</i>		

Note: SD = standard deviation. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.001$. Superscript letters indicate groupings according to Dunn's post hoc test with Bonferroni-adjusted p-values ($p < 0.05$). Groups sharing at least one letter are not significantly different; groups with no letters in common differ significantly.

5. Farmer profiles

The LCA revealed four distinct and statistically significant farmer segments. These clusters, which vary across socio-demographic, structural, behavioural, and attitudinal characteristics, define unique profiles within the Italian agricultural population. The segmentation is crucial for understanding the differential adoption and perceived value of the eco-schemes. The following subsections detail the profile of each **cluster**.

5.1. *Cluster 1: the 'animal welfare specialists'*

This cluster is strongly oriented towards eco-scheme 1 (animal welfare), showing almost universal adoption and knowledge of it. From a structural perspective, this profile is deeply anchored in livestock farming, displaying the highest rate of livestock integration in the sample. However, they show limited knowledge and adoption of other eco-schemes (2-5), and they perceive no positive impact from them. Farmers in this class are predominantly located in Piedmont and are characterised by larger-scale farms with a higher UAA and a strong intergenerational continuity, with more than two generations involved in farming and a high number of family collaborators. Crucially, they have the highest percentage of conventional farms and perceive a high level of public support. This group values the individual and tangible aspects of eco-scheme 1, likely linking it to their consolidated farm structure. Their product marketing is relatively diversified, although it is less reliant on direct selling channels. They also report a strong sense of societal recognition for their role.

5.2. *Cluster 2: the 'collective pragmatists'*

Cluster 2 displays a profile almost opposite to cluster 1 in terms of eco-schemes 2-5. They possess excellent knowledge and significant adoption of eco-schemes 2-5 (greening, olive groves, crop rotation, and melliferous crops), perceiving high benefits from these in terms of profitability, productivity, and sustainability. However, they show very low knowledge and adoption of eco-scheme 1, and they perceive its impact as almost null or negative. These farmers often operate conventional production systems and heavily rely on wholesale or intermediary-based marketing strategies. Their perception of public support is the lowest among all clusters, despite their appreciation for the coherence and impact of collective eco-schemes. This dichotomy suggests a strategic rather than ideological orientation, focusing on schemes that align with systemic efficiency and agronomic innovation.

5.3. *Cluster 3: the 'proactive and congruent farmers'*

This cluster represents the most engaged and informed group regarding all five eco-schemes. They show universal knowledge of all five eco-schemes and consistently record the highest adoption rates for almost all eco-schemes. They consistently perceive the highest impacts on profitability, productivity, and sustainability, and, notably, they rate the eco-scheme premiums as the most congruent relative to the required commitment. These farmers are often younger (with a higher proportion in the 16-24 and 25-34 age brackets) and a significant portion are located in Calabria. They have a higher representation in integrated and organic farming and frequently engage in direct sales on-farm or through cooperatives. They also perceive a high level of public support. This group aligns most closely with the objectives of eco-schemes, likely due to a combination of greater openness to innovation, understanding of benefits, and a positive perception of support. Their profile suggests a multifunctional approach to farming, integrating eco-schemes for both environmental stewardship and economic resilience.

5.4. *Cluster 4: the 'CAP sceptics'*

Cluster 4 is characterised by a generalised scepticism towards eco-schemes. They consistently report the lowest levels of adoption and knowledge for all eco-schemes, and perceive negligible or no impact on profitability, productivity, and sustainability. They also rate the premiums as the least congruent. Demographically, this group tends to have a higher proportion of farmers in Piedmont and in more mature age brackets (45-64 years). Their farms are often small (< 5 ha), conventionally managed, and predominantly rely on sales to wholesalers or intermediaries. They feel less supported by public subsidies compared with **clusters** 1 and 3. This group may be less informed, more risk averse, or simply does not perceive the added value in eco-schemes compared with their established practices. These attributes collectively indicate a marginalised segment of the farming population that may face both structural and cognitive barriers to participation in environmentally oriented policy instruments.

6. Discussion

The high participation levels observed within clusters 1-3, characterised by significant geographic localisation, suggest that eco-scheme adoption extends beyond individual rational calculation to encompass network effects. As highlighted by Schaub *et al.* (2023), homogeneous farming practices are driven by shared information, descriptive norms, and similar biophysical conditions. This imitative dynamic underlies the internal coherence of the identified clusters, where peer participation reinforces adoption within professional communities. Consequently, these clusters represent stylised profiles capturing co-occurring perceptions and behaviours within specific territorial contexts, rather than fully representative 'types' of Italian farmers.

In line with Villamayor-Tomas *et al.* (2019), the propensity to join agri-environmental schemes increases significantly when peers recommend these measures or when collective participation acquires a social and reputational value (Calvet *et al.*, 2019). Such dynamics are particularly evident in clusters 1 and 3, where sectoral concentration likely facilitates sharing of best practices, reducing

perceived uncertainty and cognitive transaction costs. While these dynamics cannot be generalised at the population level, they provide insight into structural mechanisms through which eco-scheme adoption may emerge in similar contexts characterised by strong territorial embeddedness and dense professional networks. Furthermore, the commitment to organic farming observed in cluster 3 suggests the presence of a possible synergy, whereby previous experience with sustainable practices may lower the entry barriers for new environmental instruments (Schaub *et al.*, 2023). However, this introduces a potential risk of adverse selection or ‘deadweight effects’, where eco-schemes primarily remunerate early adopters, limiting environmental additionality.

The observed heterogeneity in awareness and adoption reflects demographic and structural barriers. The pro-environmental propensity within cluster 3 aligns with Galdies *et al.* (2016) and Läßle *et al.* (2026), indicating that younger farmers are more inclined to adopt CAP innovations and organic farming, bolstered by positive perceptions of ecological benefits (Del Rossi *et al.*, 2021) and a proactive environmental attitude (Muñoz-Ulecia *et al.*, 2025). Notably, and contrary to some evidence reported by Schaub *et al.* (2023), this study suggests that higher profitability does not necessarily deter participation, implying that entrepreneurial identity and an innovative spirit can outweigh high opportunity costs (Rossi *et al.*, 2023). Conversely, cluster 4 illustrates how older farm managers, potentially constrained by path dependency, are less likely to modify established land management practices (Karali *et al.*, 2014).

A higher education level among adopters emerges as a determining factor, catalysing both technological and regulatory acceptance. However, widespread perceptions of inadequate payments and information gaps stem from the regime's innovative nature; as noted by Massfeller *et al.* (2022), disengagement motivations are often individualised. Because a standardised, top-down approach cannot resolve eco-scheme complexity (Chapman *et al.*, 2019), personalised advisory services capable of translating complex regulations into concrete economic benefits are required.

Regarding cluster typologies, cluster 1 aligns with the traditionalist profile identified by Bartkowski *et al.* (2022), albeit with a distinct focus on animal welfare. These respondents prioritise established management styles and integrate sustainability only when perceived as congruent with their existing farm structure. In contrast, clusters 2 and 3 represent pragmatic innovators, characterised by flexible decision-making and an openness to experimenting with new practices in response to external incentives. Given that awareness of alternative practices is a fundamental prerequisite for adoption (Bartkowski *et al.*, 2022), the heterogeneity of knowledge and risk perception suggests a necessary reorientation of support policies. As evidenced by Massfeller *et al.* (2022) and Schaub *et al.* (2020), increasing administrative complexity renders bespoke agricultural training and advisory services the primary tool for transforming CAP challenges into accessible opportunities across all farmer profiles (Gaál *et al.*, 2024).

7. Conclusions and policy implications

Despite their climate ambition, eco-schemes suffer from uncertainties regarding their implementation: excessive farmer choice and bureaucratic complexity risk undermining environmental impacts (Capitanio *et al.*, 2025; Mezzacapo, 2024; Runge, 2022). By focusing on management commitments rather than measurable outcomes, they remunerate farmers regardless of

actual ecological results, echoing past policy shortcomings (Brown *et al.*, 2021; Burton, Schwarz, 2013; Coderoni, 2023; European Court of Auditors, 2022).

To optimise policy coherence, future frameworks must decouple eco-schemes from basic income support, evolving towards the proactive valuation of natural capital (European Commission, 2025). Policies should be tailored to structural diversity, providing streamlined administration for smallholders and targeted incentives for larger production systems. Finally, safeguarding productivity requires deploying alternative instruments based on regional agronomic suitability. Rather than over-relying on standardised schemes, capitalising on localised territorial strengths ensures that environmental stewardship directly complements output capacity. This vocation-based approach secures EU yields, mitigates reliance on external imports, and reinforces long-term European food security and strategic autonomy.

The identification of four distinct farmer segments, here interpreted as latent configurations of co-occurring perceptions and behaviours rather than fixed farmer types, underscores the necessity of moving beyond monolithic policy designs. These groups differ not only in socio-demographic and farm characteristics, such as region, age, family structure, and UAA, but, more fundamentally, in their latent perceptions of policy utility. For instance, clusters 1 and 3 exhibit higher alignment with specific environmental objectives, whereas clusters 2 and 4 represent segments where the perceived opportunity costs and bureaucratic burdens outweigh the provided incentives. Furthermore, the marked regional distributive disparities highlight the need for policies that account for territorial specificities (Beckman *et al.*, 2022; Capitanio, 2020), particularly the structural divergences between northern and southern Italian production systems.

A critical ‘information bottleneck’ has emerged as a barrier to adoption. The limited knowledge observed, particularly within cluster 4, suggests that low cognitive accessibility and an over-reliance on intermediaries (such as agricultural assistance centres) create a principal-agent problem. These consultants may de-prioritise complex eco-schemes to avoid sanction risks or administrative overhead, effectively filtering the policy’s potential. For these marginalised segments, private transaction costs act as a regressive barrier that outweighs the flat-rate premiums offered. This is exacerbated by the ‘inversion of perception’ observed between clusters 1 and 2, where preferences are strictly tied to the nature of the scheme (individual vs collective). For adoption to be meaningful, premiums must be perceived as congruent with the total effort, including hidden transaction costs.

Strategic policy directions must therefore prioritise a differentiated approach. Strategies should target cluster 1 with refined animal welfare incentives, while clusters 2 and 3 require frameworks that bolster agronomic and environmental sustainability. For the sceptical segments, a fundamental review of premium levels or the introduction of additional transition incentives may be necessary to overcome perceived barriers. Strengthening qualified technical assistance is paramount to transforming negative perceptions into adoption potential, shifting the focus from mere bureaucratic compliance to the tangible economic and environmental benefits of sustainable practices.

The long-term stability of the CAP, which absorbs one-third of the EU budget, hinges on justifying public expenditure to taxpayers by demonstrating tangible social value and income resilience. The 2024 farmer protests highlighted the friction between rising regulatory demands and diminishing economic support (Finger *et al.*, 2024; Läßle *et al.*, 2026; Mazzocchi *et al.*, 2024). Specifically, the CAP suffered a €21.7 billion loss between the 2014-2020 and 2021-2027

frameworks (Regulation EU 2024/1468), with an additional 20% real-terms reduction projected post-2027.

Amid climate volatility, demographic pressures, and geopolitical shocks threatening food security; Capitanio, 2020, 2025), merely reallocating existing funds is insufficient. An expanded financial commitment is required to bridge the investment gap for the socio-ecological and digital transition (Matthews, 2025).

Consequently, the post-2027 architecture must redefine subsidies beyond simple income support to foster genuine environmental commitment. To counteract ‘land immobilisation’ by inactive owners, which hinders young farmers, first pillar resources must be strictly contingent on full factor traceability, ensuring support targets active, documented agricultural production.

The proposed restructuring pursues a dual objective: first, to incentivise professional agriculture that integrates quality with stewardship based on a firm’s generative capacity; and second, to establish a distinct payment channel for the provision of ecosystem services and to protect the components of nature. This latter stream should function as autonomous remuneration for environmental maintenance, ensuring such commitments do not constrain productive potential. This functional decoupling would properly value agricultural enterprise while recognising the socio-economic dignity of environmental and nature guardianship, thereby preventing land-market distortions and allocative inefficiencies (Spada *et al.*, 2026).

While the non-probabilistic nature of the sampling design calls for caution in extrapolating these findings to the entire population of Italian farmers, the results should be interpreted as analytically generalisable evidence of structural mechanisms shaping the adoption of eco-schemes. Specifically, this study highlights the role of information asymmetries, perceived transaction costs, and the interaction between farm structure and scheme design in influencing participation decisions across territorial contexts. Future research would benefit from longitudinal approaches capable of tracing how perceptions and participation patterns evolve throughout the 2023-2027 programming period. Moreover, the sample exhibits geographic imbalance, with a stronger representation of respondents from Piedmont compared with Calabria. Although this disparity was partially addressed by including region as a covariate within the LCA model, the findings should be interpreted with appropriate caution. A more balanced territorial distribution in future studies would further strengthen the empirical validation of regional differences in eco-scheme adoption dynamics.

Overall, these findings highlight the need for a differentiated policy strategy aligning economic incentives with effective communication and technical support while recognising the diversity of European agriculture.

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Author Contributions

T.M. Conceptualisation, Methodology, Writing – original draft, Writing – review & editing, Funding acquisition, Validation, Supervision;

T. P. Methodology, Data curation, Formal analysis, Investigation, Writing – original draft, Writing – review & editing;

G.G. Writing – review & editing;

A.I. D.L. Investigation, Writing – original draft, Writing – review & editing;

E.S. Conceptualisation, Methodology, Writing – original draft, Writing – review & editing, Validation, Supervision.

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