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Qualitative meta-analysis of barriers and drivers of agroecological transition

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Abstract: The agri-food sector contributes to climate change but also has substantial mitigation potential. Agroecology is increasingly recognised as a viable pathway for transforming agri-food systems, but its success depends partly on understanding the factors influencing farmers' pro-environmental behaviour. This study aims to identify and classify these factors as barriers or drivers through a qualitative meta-analysis based on a structured systematic literature review of studies conducted in the European Union. The results indicated that personal knowledge and capabilities dominated the evidence. Particularly advanced age and income-related constraints were the clearest barriers, whereas larger farm size, higher schooling level and agricultural training were the most consistent drivers. Subsidies, off-farm income, technical advice, family labour, environmental attitude and innovativeness show positive but less consistent effects. The findings indicate that policies supporting the agroecological transition should strengthen farmers' financial stability, training and capacity to adopt agroecological land management practices, particularly among older and structurally constrained farmers.

Keywords: adoption barriers; adoption drivers; agroecology; agroecological land management practices; qualitative meta-analysis

Reducing the environmental footprint of agriculture is central to global sustainability agendas, including the Sustainable Development Goals (Wezel et al. 2014). Because farmers implement land-use decisions, their behavioural adaptation is key to any agri-food transition. Accordingly, farmer pro-environmental behaviour has received increasing attention (Milliet et al. 2023). Such behaviour is commonly defined in terms of both impact, understood as observable action, and intention, understood as a deliberate commitment to act (Whitmarsh 2009). Therefore, it is important to clarify what constitutes

pro-environmental actions by farmers, which, according to the literature, largely involves participation in some kind of nature conservation programme (Milliet et al. 2023).

Agroecology is widely framed as a transformative new paradigm for agri-food systems, integrating ecological and social principles into the design and management of food systems (FAO 2018). FAO (2018) defines 10 principles of agroecology, implemented through so-called agroecological practices that aim to balance food production with ecological processes (Wezel et al. 2014). They may be classified as weak when they focus mainly

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on efficient resource use or as strong when they rely on biodiversity-based solutions and deeper system redesign (Duru et al. 2015; Rööß et al. 2021). Instruments within the Common Agricultural Policy (CAP) can be considered as operational proxies for agroecological land management practices (ALMP) because they embed core principles such as biodiversity enhancement, closed nutrient cycles, or reduced reliance on external inputs (Wezel et al. 2014; EC 2021). For example, conditionality (EC 2021) can be treated as weak agroecological practices, whereas others, such as eco-schemes (EC 2021), and mostly agri-environment-climate schemes (EC 2005), and regulation on organic production (European Union 2018) can be regarded as strong agroecological practices (Mishra et al. 2019).

The adoption of ALMP is shaped by a wide range of influences that may act as barriers (negatively) or drivers (positively). Following the behavioural literature, such influences can be classified into psychosocial and personality factors (internal, e.g. personal knowledge and capabilities, and personality traits), and contextual factors (external) (Goldman et al. 2020). Although research has often emphasised internal determinants, external constraints and opportunities remain less developed in the empirical evidence base (Sulemana and James 2014). This paper addresses that gap by identifying and classifying the factors that influence farmers' ALMP adoption in European contexts. To this end, a structured literature review (SLR) and a qualitative meta-analysis using the vote-counting technique were used to synthesise empirical evidence on the direction and statistical significance of these factors across EU member states, the United Kingdom, and Norway (collectively, EU+).

MATERIAL AND METHODS

Literature search and selection criteria. A structured literature review (SLR) was conducted to identify, collect and classify the relevant empirical literature. Following Massaro et al. (2016), the review was designed to be systematic, transparent and replicable by defining research questions, developing a protocol, establishing a coding framework and selecting an appropriate synthesis strategy. Six research questions, grouped into two categories, guided the review:

G1 – Farmer-level adoption of agroecological land management practices (ALMP).

RQ1. How has the literature on the adoption of agri-environmental schemes (strong agroecological practices) evolved in the EU+?

RQ2. How has the literature on the adoption of ecosystem services measures (strong agroecological practices) evolved in the EU+?

RQ3. How has the literature on the adoption of organic farming (strong agroecological practices) evolved in the EU+?

RQ4. How has the literature on the adoption of conservation practices or integrated production (weak agroecological practices) evolved in the EU+?

G2 – Barriers and drivers of farmers' farm-level adoption of ALMP.

RQ5. What are the main barriers and drivers of farmers' adoption of ALMP in the EU+?

RQ6. What is the statistical significance and direction of the association between these barriers and drivers and the adoption of ALMP in the EU+?

The study was conducted in the EU, covering the 27 member states plus the United Kingdom – a member state until 2020 – and Norway – given economic integration – (collectively, EU+). Regarding G1, Linares-Quero et al. (2022) highlight the role of CAP Pillar II instruments, such as agri-environmental measures and support for organic production, in promoting the agroecological transition in the EU, while also considering other CAP-based conservation practices (EC 2021), such as integrated production. Moreover, there exists an added complexity due to three distinct mechanisms for eliciting behaviours in farmers' sustainable land management practices at the farm level (Burke and Running 2019): actual behaviour, self-reported behaviour, and self-reported intention. The G2 aimed to identify the main internal and external barriers and drivers influencing the adoption of ALMP, using the aforementioned instruments to assess the statistical significance and sign of the reported associations.

The protocol was developed between February and September 2023 following PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The Scopus database was used because of its broader journal coverage than the Web of Science (WoS) database. The search was limited to English-language, peer-reviewed empirical studies published from 2000 to 2023, conducted in the EU countries covered by the search protocol, and reporting the statistical significance and direction of associations between explanatory factors and ALMP adoption (inclusion criteria). The 2000 starting point reflects the post-Agenda 2000 period, when the adoption of ALMP was increasingly supported through the expansion of agri-environmental measures (EC 2005).

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Data extraction. A coding framework was established to capture key themes and concepts. The four-stage PRISMA process was followed (Liu et al. 2023): identification; screening; eligibility assessment; and inclusion and synthesis. First, a series of search strings was constructed, using keyword queries with Boolean operators (Table S1 in the Electronic Supplementary Material – ESM). The database retrieved 1 687 papers (Figure 1). After excluding 122 non-English or non-peer-reviewed records, 1 565 papers were screened on title, abstract and keywords, and 747 were removed because they did not meet the preliminary inclusion criteria. Full-text assessment of the resulting 818 papers, excluded an additional 760 papers that did not report adoption outcomes (barriers or drivers) and/or did not provide the statistical significance and direction of effects. This left 58 eligible studies. To minimise omission bias, snowballing in search Google Scholar added 8 studies, yielding a final corpus of 66 studies.

Each stage was conducted independently by two researchers, and disagreements were resolved through discussion until consensus was reached. Although the protocol was not externally validated, the complete search strategy and full screening flow are provided in the Table (ESM), ensuring full reproducibility.

To build the analytical dataset, two researchers independently extracted all factors linked to farmers' ALMP adoption. Synonyms were harmonised, and compound items disaggregated where necessary, yielding 39 factors. Because many factors appeared only rarely, only those reported in at least 5 papers were retained for analysis, yielding 16 factors. Three team members then classified each factor as internal or external following Goldman et al. (2020). Internal factors were divided into psychosocial and personality ones, and external factors into contextual or situational factors. Hines et al. (1987) include knowledge of action as procedural knowledge (know-how about options for action

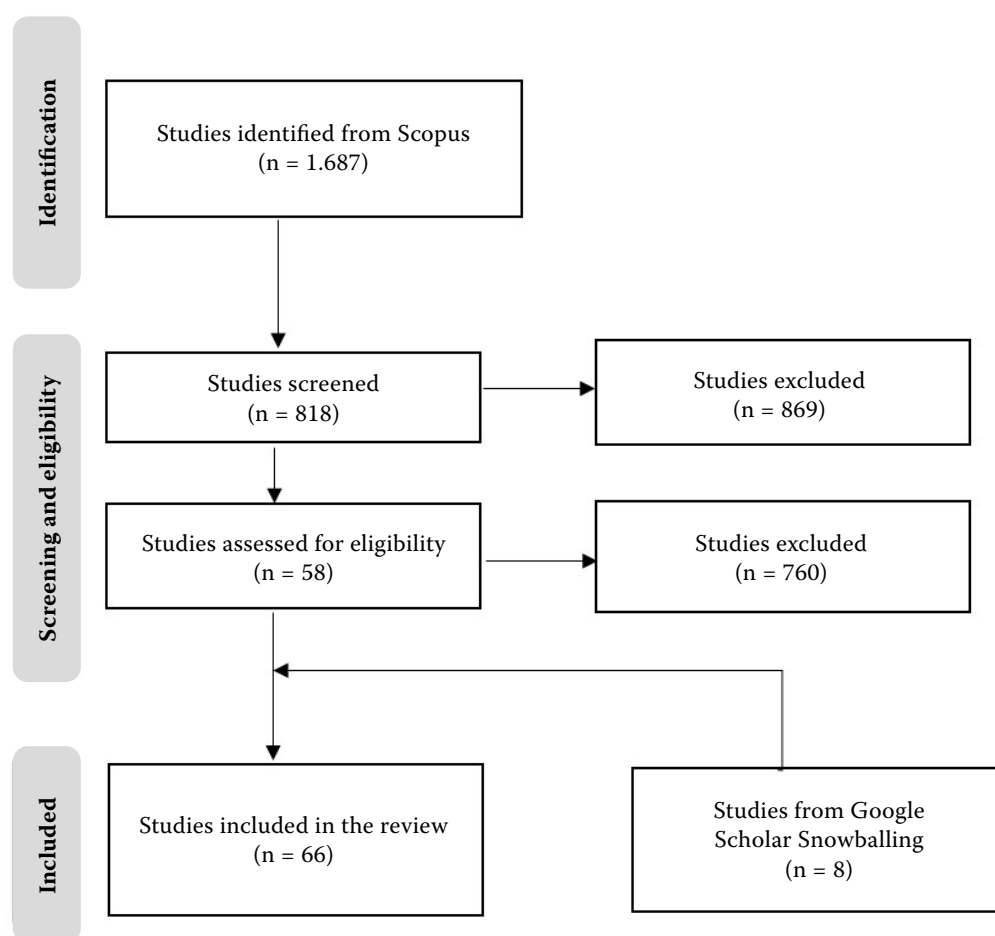


Figure 1. PRISMA flow diagram of the systematic review process

Source: Authors' elaboration

and how to participate), while Stern (2000) uses the term personal capabilities, adding capabilities related to time, money, power, and resources. Personality traits involve not only responsibility (Hines et al. 1987) but also motivational and affective learning goals (Stern 2000). For external factors, contextual ones include constraints and opportunities, such as technology, policies, and regulations (Stern 2000). Situational factors, in turn, encompass cues of either positive or negative behaviour exhibited by others (Steg et al. 2014). Inter-coder reliability was substantial, with 87% raw concordance; the remaining differences were resolved in a consensus meeting.

Data analysis. A qualitative meta-analysis was conducted using the vote-counting technique (Light and Smith 1971) on the 16 factors identified in the SLR. Because the primary literature is methodologically heterogeneous and often omits the statistics needed to compute a common effect size, vote-counting was chosen over a quantitative meta-analysis. Vote-counting involves analysing and classifying the reported associations for each factor as positive, negative, or non-significant (Borenstein et al. 2009); the modal outcome indicates the prevailing direction of an effect (Koricheva and Gurevitch 2013). Its main limitation is that each study receives equal weight regardless of sample size or econometric specification, which may increase the risk of Type-II error in studies with small sample sizes or split-sample designs for between-subject comparisons (Koricheva and Gurevitch 2013). Nevertheless, vote-counting is appropriate for our study, as more than 95% of studies have samples of more than 100 observations, which helps mitigate this bias.

Following McKenzie and Brennan (2023), three 2×2 contingency tables were constructed for each factor: positive *vs.* negative, positive *vs.* non-significant and non-significant *vs.* negative. Pearson's χ^2 tests assessed whether the distribution of effect patterns deviated significantly from a 50/50 uniform distribution. This allowed us to test whether one type of effect tended to dominate for a given factor, or whether the effects were equally distributed, suggesting no clear directional pattern. Given the restricted geographical scope of the corpus (EU member states plus the United Kingdom and Norway), the inherent risk of Type-II error in qualitative syntheses, and the exploratory nature of the multiple testing, a 90% confidence threshold was adopted. Additionally, to assess the internal consistency of the vote-counting results (McKenzie and Brennan 2023), 3×3 contingency tables were constructed to cross-check the significance levels for selected pairs of factors – specifically those most frequently

studied and with the highest proportion of significant findings, and again Pearson's χ^2 test was applied.

A sensitivity analysis tested the robustness of the vote-counting results, following McKenzie and Brennan (2023). Pearson's χ^2 test examined whether the distribution of vote-counting outcomes differed significantly across two methodological strata: (i) statistical power, proxied by a sample sizes exceeding 400 observations, a threshold associated with acceptable predictive accuracy when multiple covariates are included (Van Voorhis and Morgan 2007); and (ii) journal quality, proxied by publication in journals ranked in the top quartile (Q1) of the Journal Citation Reports (JCR), where editorial standards are associated with lower publication bias (Higgins et al. 2019). Because the methodological strategy involved multiple hypothesis tests, the Benjamini–Hochberg correction (Benjamini and Hochberg 1995) was applied to control the false discovery rate (FDR), balancing the need to limit Type-I error inflation while maintaining sufficient statistical power to detect meaningful differences.

RESULTS AND DISCUSSION

Structured literature review. The SLR approach addressed the first group of research questions. The 66 reviewed studies are summarised in Table S2 (ESM) by authors, publication year, data type, sample size, type of ALMP, crop types, country, econometric specifications, behaviour measures (actual, self-reported adoption, and self-reported intention to adopt) and journal ranking in the year of publication (Q1 *vs.* non-Q1). 36 studies used sample sizes ranging from 36 to 400 observations, while 30 analysed datasets with more than 400 observations. The adoption of agri-environmental schemes was the most frequently analysed ALMP (47 papers), followed by organic farming (8 papers). Only one paper directly addressed the adoption of agroecology as such. Crop-specific studies were less common, and only 18 papers focused on specific crops, mainly olive groves (10 papers) and vineyards (5 papers), while cereals, citrus, vegetables, avocados, and legumes were each covered by one study.

As shown in Figure 2, publication peaks occurred in 2015 and 2022, with 8 papers in each year. The corpus averaged approximately 3 papers per year.

The datasets used in the selected studies were collected between 1996 and 2022, with most collected in 2012 (Figure S1, ESM). Only 10 papers relied on secondary data. Geographically, the evidence was concentrated in Italy and Spain, as illustrated in Figure 3.

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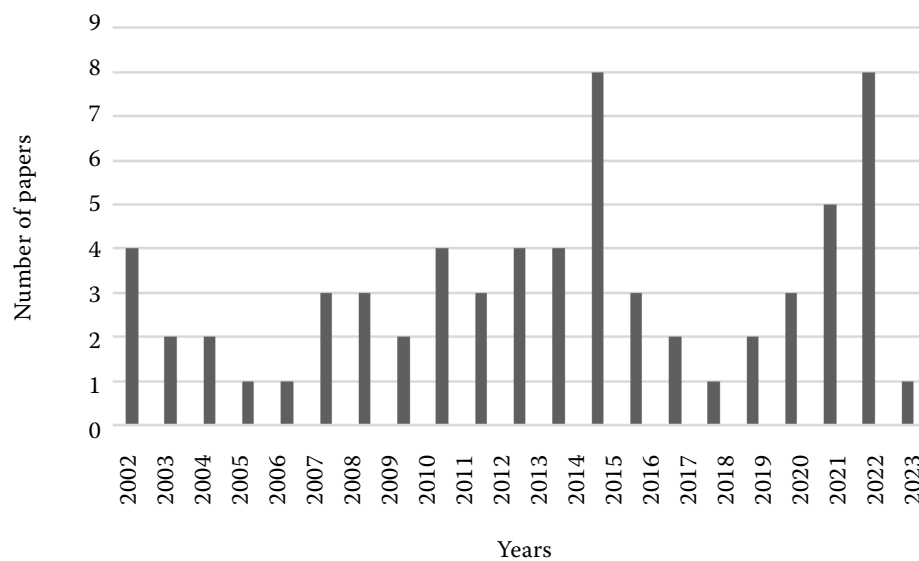


Figure 2. Number of papers over time

Source: Authors' elaboration

Econometric approaches in the corpus were strongly oriented towards discrete-choice frameworks. 33 studies used traditional discrete choice analysis, 26 used choice experiments, 6 used contingent valuation, and 1 used another regression analysis (Table 1). Common specifications included traditional binary logit and probit, typically modelling actual or self-reported adoption of ALMP, and a random parameter logit model (also known as mixed logit model), often modelling self-reported intention in choice experiments.

Finally, a co-occurrence network analysis of the keywords was performed using VOSviewer software (Van

Eck and Waltman 2022). Figure 4 shows that the main topics were agri-environmental schemes, choice experiments and willingness to accept. Other frequent keywords included organic farming, payments for ecosystem services, and contingent valuation.

Vote-counting. The vote-counting synthesis addressed the second group of research questions. Of the 39 factors initially identified, 16 appeared in at least five studies and were retained for analysis (the remaining 23 are presented in Table S3 in the ESM). The 16 key factors were grouped into three categories (Table S4, ESM). 11 were classified as personal knowledge and



Figure 3. Geographical distribution of studies

Source: Authors' elaboration

Table 1. Methodological approaches used in the reviewed studies

Methodological approaches	Repeated outcomes	Econometric specifications	Correlation between outcomes	No. of papers
Traditional discrete-choice analysis	no	binary probit model	no	7
	yes	binary probit model	no	3
	yes	multinomial logit model	no	8
	no	binary logit model	no	6
	yes	binary logit model	no	1
	no	ordered probit	no	2
	yes	trivariate ordered probit	yes	1
	yes	trivariate probit	yes	2
	yes	random effect logit	yes	1
	yes	a-spatial fractional logit	no	1
	yes	multivariate probit	yes	1
	yes	random parameter logit model	yes	11
	yes	latent class	yes	5
	yes	latent class + binary probit model	yes	1
	yes	binary logit model	no	1
Choice experiment	yes	ordered logit	yes	1
	yes	error component random parameter logit	yes	1
	yes	random parameter hybrid choice	yes	1
	yes	conditional logit	no	2
	yes	bivariate probit model	yes	2
	yes	random parameter logit + linear regression	yes	1
	yes	binary probit model	no	2
Contingent valuation	no	binary probit model	no	2
	yes	bivariate probit model	yes	1
	no	linear regression	no	1
Other	no	Tobit	no	1

Source: Authors' elaboration

capabilities, linked to farmers' ability to evaluate costs and benefits, including time availability, liquidity, managerial control, access to physical resources, and demographic characteristics. Three were contextual factors, representing external opportunities or constraints on pro-environmental behaviours, such as policy incentives, market signals and biophysical endowments. Only two factors were personality traits, namely environmental attitude and innovativeness. Notably, no situational factors were identified.

Figure 5 shows the distribution of positive, negative and non-significant votes for each factor. In addition, Table 2 reports the results of Pearson's χ^2 test for these distributions.

Personal knowledge and capabilities dominated the empirical literature. Farm size was analysed in 46 papers

and was significant in 43% of the corpus. It generally acted as a driver, with 29% (19 out of 66) reporting a positive association, suggesting that larger farms are more likely to adopt ALMP. Yet, the imbalance between positive and negative findings was not statistically significant ($\chi^2 = 2.79$, $P > 0.10$). This heterogeneity is consistent with evidence that larger farms may be better equipped to adopt ALMP, while smaller farms may sometimes face lower adjustment costs or more easily meet specific standards (Ruto and Garrod 2009; Läpple and Rensburg 2011; Beltrán-Estevé et al. 2012; Dinis et al. 2015). A key issue is the definition of 'small farm' across EU contexts – thresholds range from 0.3 ha to 4 ha under the Small Farmers Scheme (European Parliament 2025).

Schooling level showed a clearer pattern. It was studied in 38 papers and was significant in 36% of the corpus.

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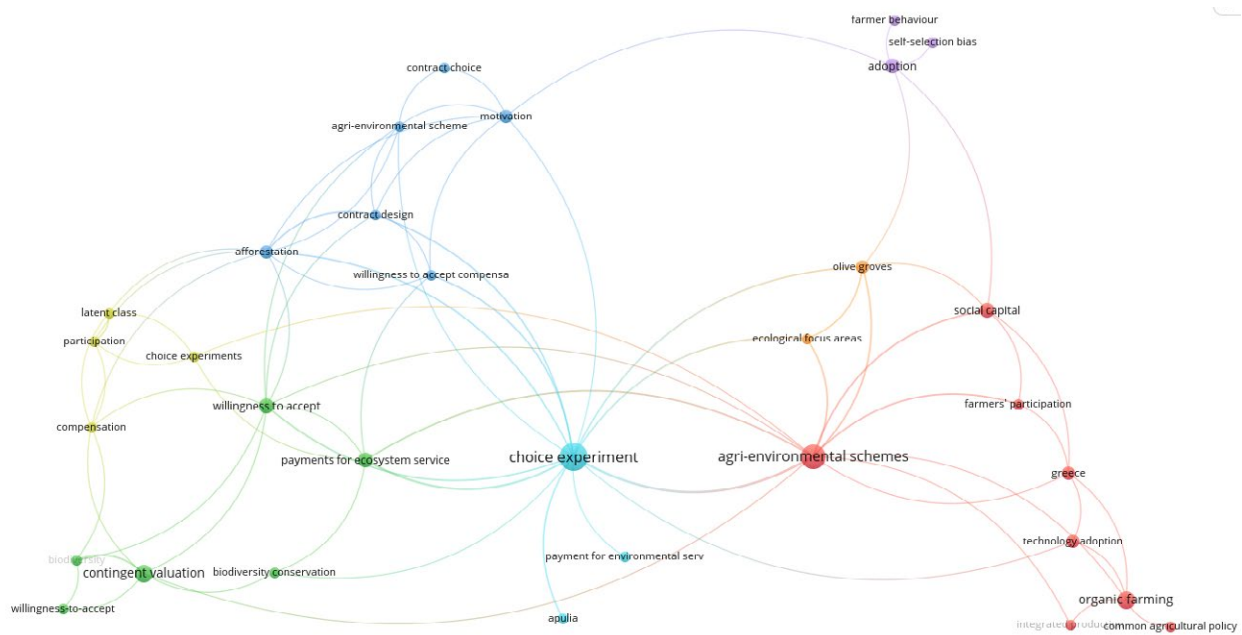


Figure 4. Co-occurrence network of keywords in the selected papers

Source: Authors' elaboration

32% (21 out of 66) showed a positive association with adoption, identifying schooling as a driver ($\chi^2 = 13.50$, $P < 0.01$). This is consistent with evidence that more educated farmers are better able to navigate regulatory and bureaucratic requirements (Micha et al. 2015).

Farm income showed the opposite pattern. It appeared in 18 studies and was significant in 15% of the corpus, with a negative association in 14% (9 out of 66); the vote distribution was statistically significant ($\chi^2 = 6.40$, $P < 0.05$). Off-farm income partly offset this constraint.

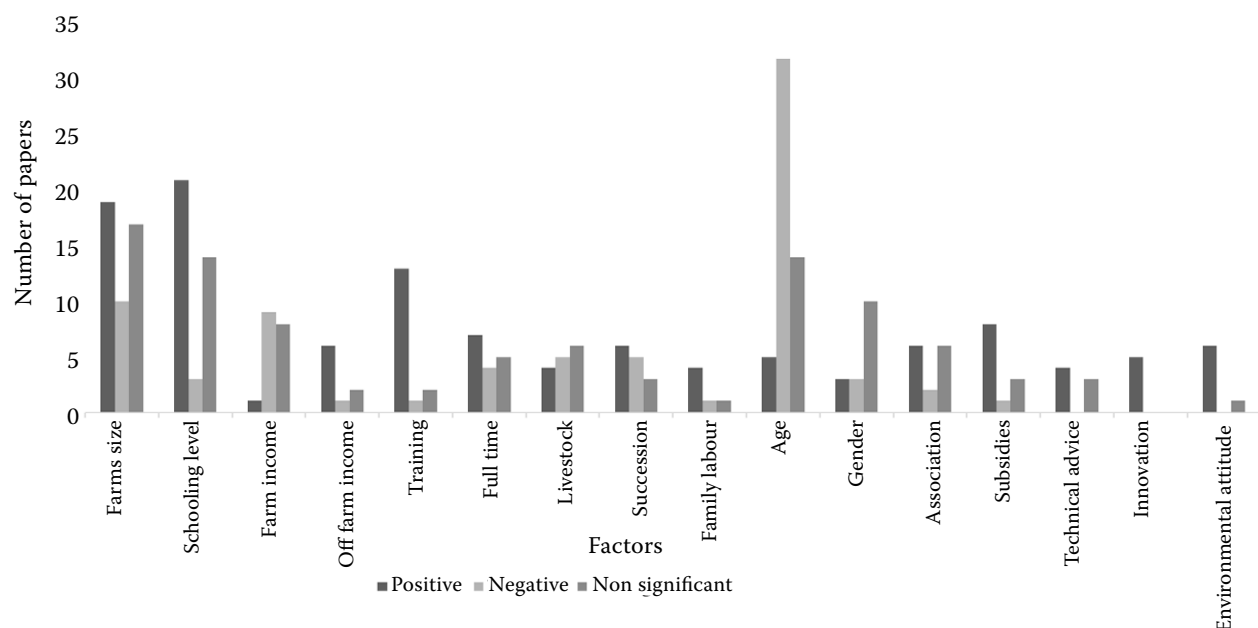


Figure 5. Vote-counting results for each factor affecting agroecological land management practices adoption

Source: Authors' elaboration

Table 2. Pearson's χ^2 tests for each factor of ALMP adoption: positive vs. negative, positive vs. non-significant, and negative vs. non-significant

Category	Factors	Pearson's χ^2 tests with Benjamini–Hochberg correction approach		
		positive vs. negative	positive vs. non-significant	negative vs. non-significant
Personal knowledge and capabilities	farms size	2.79 ^{ns}	0.11 ^{ns}	1.81 ^{ns}
	schooling level	13.50 ^{***}	1.40 ^{ns}	7.12 [*]
	farm income	6.40 ^{**}	5.44 [*]	0.06 ^{ns}
	off-farm income	3.57 ^{ns}	2.00 ^{ns}	0.33 ^{ns}
	training	10.29 ^{***}	8.07 [*]	0.33 ^{ns}
	full-time	0.82 ^{ns}	0.33 ^{ns}	0.11 ^{ns}
	livestock	0.11 ^{ns}	0.40 ^{ns}	0.09 ^{ns}
	succession	0.09 ^{ns}	1.00 ^{ns}	0.50 ^{ns}
	family labour	1.80 ^{ns}	1.80 ^{ns}	0.00 ^{ns}
	age	19.70 ^{***}	4.26 ^{ns}	7.04 [*]
Contextual factors	gender	0.00 ^{ns}	3.77 ^{ns}	3.77 ^{ns}
	association	2.00 ^{ns}	0.00 ^{ns}	2.00 ^{ns}
	subsidies	5.44 [*]	2.27 ^{ns}	1.00 ^{ns}
Personality traits	technical advice	4.00 ^{ns}	0.14 ^{ns}	3.00 ^{ns}
	environmental attitude	6.00 ^{**}	3.57 ^{ns}	1.00 ^{ns}
	innovation	5.00 [*]	5.00 [*]	na

^{*}, ^{**} and ^{***}significance at the 10%, 5% and 1% levels, respectively; ^{ns}not statistically significant; ^{na}Pearson's χ^2 tests could not be applied due to insufficient observed frequencies; ALMP – agroecological land management practices

Source: Authors' elaboration

Among the 9 studies, 10% of the corpus reported a significant effect, and 9% (6 out of 66) showed a positive association with adoption, although heterogeneity prevented statistical significance ($\chi^2 = 3.57$, $P > 0.10$). This supports the interpretation that expected on-farm income losses discourage adoption unless complementary income sources are available (Defrancesco et al. 2008; Ruto and Garrod 2009; Unay-Gailhard and Bojnec 2016). Agricultural training was one of the most consistent drivers. It was examined in 16 studies, with 21% of the sample reporting a significant impact and 20% (13 out of 66) reporting a positive association, confirming it as a driver ($\chi^2 = 10.29$, $P < 0.01$). This suggests that procedural knowledge and knowledge transfer facilitate the uptake of environmentally beneficial practices and improve understanding of alternative production approaches (Bartolini and Vergamini 2019).

By contrast, full-time farming, livestock, succession and family labour produced mixed results. Full-time farming was examined in 16 studies; 11 studies (17% of the full corpus) reported a significant effect. It tended to be positive (11% – 7 out of 66), but not significantly so ($\chi^2 = 0.82$, $P > 0.10$). However,

Schulz et al. (2014) suggest that full-time farmers tend to favour more sustainable, less intensive measures because they require less working time. Likewise, Rodríguez-Entrena and Arriaza (2013) find that when farming is a primary occupation, farmers' deeper knowledge of sector practices increases the likelihood of adopting ALMP. Livestock intensity showed an even less consistent relationship with ALMP adoption. Across 15 papers, 13% of the corpus reported a statistically significant effect: 6% positive (4 out of 66) and 8% negative (5 out of 66). Indeed, the χ^2 test was non-significant ($\chi^2 = 0.11$, $P > 0.10$). Findings on farm succession were similarly inconclusive. 14 studies examined this factor, with 16% reporting a significant effect: 9% positive (6 out of 66) and 8% negative (5 out of 66). Again, the χ test was not significant ($\chi^2 = 0.09$, $P > 0.10$). Ruto and Garrod (2009) suggest that the mixed results may reflect farmers' reluctance to enter long-term contracts that could constrain their successors. Family labour was addressed in only 6 studies, and in 8% of these, a significant effect was found, with a positive association in 6% (4 of 66). The χ^2 test was also not significant

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($\chi^2 = 1.80$, $P > 0.10$). Mozzato et al. (2018) propose that willingness to adopt can increase when decisions are shared among several family members, although this was not always the case.

Age was the most frequently studied factor, appearing in 51 papers, and was significant in 56% of the corpus. Negative estimates strongly dominated: 48% (32 out of 66 vs. 5 out of 66 positives). The χ^2 test was significant (19.70, $P < 0.01$), indicating that age was the most robust barrier. This finding aligns with evidence that younger farmers are often more receptive to new technologies and practices (Malá and Malý 2013), whereas older farmers may be more conservative or risk-averse (Polman and Slangen 2008). Even so, Barreiro-Hurlé et al. (2008) argue that older farmers may favour agri-environmental measures because the requirements are relatively easy to implement. Gender, by contrast, remained ambiguous. 16 studies examined this factor, and it was significant in only 9% of the corpus, and the direction was evenly split, yielding $\chi^2 = 0.000$ ($P > 0.10$). Indeed, Sardaro et al. (2021) indicate that adoption is more dependent on the farmers' level of education than on gender.

Among contextual factors, membership in agricultural associations was inconclusive. It appeared in 14 studies and was significant in 12% of the corpus, with a positive association in 9% (6 out of 66), but it showed no significant overall pattern ($\chi^2 = 2.00$, $P > 0.10$). Subsidies were more consistent. 12 studies incorporated some measure of subsidy support, and it was significant in 15% of the corpus, with 12% (8 out of 66) reporting a positive association. The χ^2 test confirmed ($\chi^2 = 5.44$, $P < 0.10$) that subsidies were a driver of participation when compensation is sufficient to cover implementation costs (Defrancesco et al. 2008) or support new business models (Bartolini and Vergamini 2019). Indeed, Giovanopoulou et al. (2011) show that a perceived low level of payment decreases the likelihood of farmers' pro-environmental behaviour. Technical advice also emerged as a driver of ALMP adoption, although it appeared in only 7 studies and was significant and positive in 6% (4 out of 66), resulting in a non-significant χ^2 test ($\chi^2 = 4.00$, $P > 0.10$), despite evidence that advisory services can reduce the compensation required for participation (Espinosa-Goded et al. 2010; Lienhoop and Brouwer 2015).

The only personality traits that met the inclusion threshold were environmental attitude and innovativeness. Environmental attitude appeared in 7 studies and was significant and positive in 9% (6 out of 66), yielding

a significant χ^2 test ($\chi^2 = 6.00$, $P < 0.05$). Innovativeness displayed a similar pattern, with 5 significant and positive results (8% of the corpus) and a significant χ^2 test ($\chi^2 = 5.00$, $P < 0.10$). These results are consistent with behavioural models linking pro-environmental action to values, attitudes and prior experience with new technologies (Barreiro-Hurlé et al. 2008; Ducos et al. 2009).

Finally, pairwise Pearson's χ^2 tests for the factor that were both most frequent and most often significant showed that adoption determinants did not operate in isolation (Table S5, ESM). Age was significantly associated with farm size ($\chi^2 = 12.13$, $P < 0.05$), i.e. whenever age mattered in a given study, farm size tended to matter as well. This pattern aligns with Gemtou et al. (2024), who report that younger farmers are more willing to adopt climate-smart agriculture and that larger farms benefit from lower unit costs and reduced managerial complexity when implementing such practices. Farm size was also significantly linked to both schooling level ($\chi^2 = 13.02$, $P < 0.05$) and farm income ($\chi^2 = 13.15$, $P < 0.05$), indicating that physical and human capital tend to be concentrated on certain holdings. Guo et al. (2020) reach a similar conclusion in their meta-analysis of 21 African studies, noting that land and education can accumulate among better-resourced producers. However, Finizola e Silva et al. (2024) find that smallholders with lower on-farm incomes are more inclined to adopt climate-smart agriculture practices. No significant association emerged between age and farm income ($\chi^2 = 1.20$, $P > 0.10$), age and schooling level ($\chi^2 = 8.24$, $P > 0.10$), and farm size and training ($\chi^2 = 4.51$, $P > 0.10$), mirroring the ambiguous effects highlighted in Finizola e Silva et al. (2024).

Sensitivity analysis. To test robustness, the vote-counting statistics were re-estimated after partitioning the corpus by study sample size and journal quality. The sample-size split used 400 observations as the threshold, and the journal-quality split distinguished Q1 from non-Q1 journals. Tables 3 and 4 report Pearson's chi-square statistics.

When statistical power was used as the reference stratification, no factor showed a statistically significant difference in vote-counting outcomes between high- and low-sample-size studies. This suggests that the main patterns are broadly consistent across sample sizes.

The journal-quality stratification (Table 4) painted a similar picture.

Table 3. Sensitivity analysis stratified by study sample size (> 400 vs. ≤ 400 observations)

Category	Factors	Pearson's χ^2 test
Personal knowledge and capabilities	farm size	5.46 ^{ns}
	schooling level	0.56 ^{ns}
	farm income	0.90 ^{ns}
	off-farm income	0.75 ^{ns}
	training	3.11 ^{ns}
	full-time	4.52 ^{ns}
	livestock	8.18 ^{ns}
	succession	5.28 ^{ns}
	family labour	2.62 ^{ns}
	age	1.30 ^{ns}
	gender	0.82 ^{ns}
Contextual factors	association	0.38 ^{ns}
	subsidies	1.54 ^{ns}
	technical advice	0.19 ^{ns}
Personality traits	environmental attitude	1.55 ^{ns}

^{ns}non-statistically significant, Benjamini–Hochberg correction was applied; factors that did not meet Pearson's χ^2 requirements due to insufficient observed frequencies are not reported in this table

Source: Authors' elaboration

The journal-quality stratification showed the same pattern. No statistically significant differences were found for the analysed factors, indicating that

the vote-counting results are broadly stable across publication quartiles and are not driven by Q1 journals alone.

Table 4. Sensitivity analysis stratified by journal impact (Q1 vs. non-Q1)

Category	Factors	Pearson's χ^2 test
Personal knowledge and capabilities	farms size	0.98 ^{ns}
	schooling level	4.91 ^{ns}
	farm income	1.16 ^{ns}
	off-farm income	1.57 ^{ns}
	training	1.02 ^{ns}
	full-time	0.34 ^{ns}
	livestock	2.41 ^{ns}
	succession	1.20 ^{ns}
	family labour	2.00 ^{ns}
	age	1.55 ^{ns}
	gender	3.73 ^{ns}
Contextual factors	association	1.13 ^{ns}
	subsidies	2.25 ^{ns}
	technical advice	3.73 ^{ns}
Personality traits	environmental attitude	2.91 ^{ns}

^{ns}non-statistically significant, Benjamini–Hochberg correction was applied; factors that did not meet Pearson's χ^2 requirements due to insufficient observed frequencies are not reported in this table

Source: Authors' elaboration

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CONCLUSION

Agroecology offers a plausible pathway for transforming the EU's agri-food system. Based on a structured literature review of 66 empirical studies and a qualitative meta-analysis of 16 frequently reported factors, this study shows that personal knowledge and capabilities dominate the evidence on farmers' ALMP adoption. Schooling level and agricultural training are the most consistent drivers, while the association between adoption and farm size tends to be positive but heterogeneous. Age is the strongest barrier, and income-related constraints also reduce adoption. Subsidies, off-farm income, technical advice, family labour, environmental attitude and innovativeness generally support adoption, although their effects are less consistently reported. Evidence on gender, livestock and succession remain inconclusive and warrant further research.

The results suggest three policy priorities for the post-2027 CAP. First, because older farmers are less inclined to adopt ALMPs and, on average, have lower levels of formal education, tailored training programmes should address their specific informational, managerial and risk-related constraints. Second, support mechanisms should be recalibrated to reduce the structural disadvantages that limit adoption by small or financially constrained farms. Third, generational-renewal instruments within the CAP's new green architecture could be linked, through the basic payment, to verifiable commitments to sustainable production, thereby easing entry for younger farmers while supporting farm development.

These conclusions, however, should be interpreted with caution. The evidence is geographically uneven, with studies concentrated in countries such as Spain and Italy and thinner coverage of Northern and Eastern Europe. In addition, the inclusion criteria excluded studies that did not report both statistical significance and the direction of the effect. Although these restrictions improve methodological comparability, they limit the generalisability of our results beyond European settings and beyond qualitative or non-parametric evidence. Future studies should report effect sizes, significance levels, and consistent definitions for understudied factors such as gender, livestock intensity, succession intentions, and environmental attitudes, to build a more comprehensive foundation for future policy design.

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