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Design principles for result-based, collective and value chain-based environment and climate contract solutions in agriculture and forestry: Learning from 44 case studies across Europe

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ABSTRACT

The European Union promotes the provision of agri-environment-climate public goods (AECPGs) from agriculture and forestry through dedicated policies. Nevertheless, despite long-term efforts and earmarking of significant financial resources for voluntary agri-environmental schemes, the provision of AECPGs from Europe's agro-ecosystems is continuing to decline. New governance instruments are urgently required to revert this process. Promising new approaches are seen in novel contract solutions promoting result-based payments, collective implementation, and value-chain-based approaches. However, a deeper understanding of the practical design of these novel schemes is needed to achieve acceptance and successful implementation. We systematically examine real-world examples of contract solutions and their design characteristics by analyzing a dataset of 44 case studies from 13 European countries. Data or information from these case studies was collected using a uniform protocol across countries, and a qualitative content analysis was conducted. Our findings show that result-based approaches differ in their design with regard to measuring environmental performance. Successful result-based approaches enable flexible management, include features for knowledge provision, and are often designed as hybrid solutions to enhance uptake, combining action- and result-based elements. Collective contract solutions are based on a common management agreement of the involved group members, but vary in their degree of formalization, often include a coordinator, and foster meetings and exchanges. Value chain-based solutions differ in terms of the relationship between the production of private goods and the provision of AECPGs, their incentive system, value chain characteristics, and marketing, and often comprise an element of cooperation, also representing a hybrid approach. The findings of this research can help shape the design of such alternative approaches

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and provide inspiration for promoting the voluntary delivery of AECPGs under the Common Agriculture Policy (CAP) and beyond.

1. Introduction

Degradation and the impairment of environmental goods and services by agricultural production and forestry remain pressing governance challenges in Europe. Many agri-environment-climate public goods (AECPGs), such as biodiversity, water, and soil quality are in decline with no clear sign of a reverse in trends (Campbell et al., 2017; European Environment Agency, 2025; Foley et al., 2011; Poore and Nemecek, 2018; Röder et al., 2024). Particularly against the background of the threats due to climate change and biodiversity loss, in 2019, the EU Green Deal in its Farm-to-Fork Strategy and Biodiversity Strategy have aimed to tighten the direction and targets for environmental and climate improvement by European agriculture (European Commission, 2019). Moreover, the EU Common Agriculture Policy (CAP) for the years 2023–2027 has been equipped by a new framework, the so-called "green architecture", utilizing several instruments to counteract the adverse effects of agricultural management on the environment. Conditionality has been enhanced, and the novel instrument of eco-schemes has been integrated as an additional key policy lever of the first pillar, complementing the agri-environmental-climate schemes (AECS) of the second pillar in order to better integrate environmental objectives into CAP payments (European Parliament and Council, 2021; Runge et al., 2022).

However, both past and current CAP instruments for environmental improvements are facing criticism. Despite being considered "expensive", they have been and are assessed as unsatisfactory in addressing environmental degradation and climate change (Bateman and Balmford, 2018; European Court of Auditors, 2024; Guyomard et al., 2023; Heyl et al., 2021; Pe'er et al., 2019; Reif and Vermouzek, 2019; Scown et al., 2020). Particularly criticized are insufficient spatial targeting, lacking consideration of synergies and trade-offs between objectives (Batáry et al., 2015; European Court of Auditors, 2011; Früh-Müller et al., 2019), weakness of regulatory agencies, as well as slow and inflexible processes between the recognition of a problem and the implementation of measures. Moreover, being predominantly designed as action-oriented schemes, i.e. remuneration being based on the implementation of specific prescribed management practices on the farms or fields (European Court of Auditors, 2011; Groth, 2009), current AECS design does not support farmers' capacity for innovation and flexibility in integrating and reaching environmental goals (Burton et al., 2008; Sabatier et al., 2012). Also, existing AECS are generally aimed at individual contractors and therefore mostly only relate to individual fields or farms. Consequently, they are poorly suited to improving landscape-level public goods, such as water quantity or quality, nor do they allow for the creation of interconnected habitats (Dupraz et al., 2009; Kleijn et al., 2011).

In addition to the limited effectiveness of public funding mechanisms, most environmental goods and services are non-rival and non-excludable due to their public nature, actors on the demand side of the food supply chain, such as food processors, retailers, and consumers, are generally neither interested in nor actively involved in their provision or payment (United Nations Environment Programme, 2015). Consequently, market-based incentives for the provision of environmental goods and services from agriculture and forestry so far remain underdeveloped and insufficiently effective to drive a broad transition of EU agricultural production systems toward greater environmental sustainability.

Given these difficulties and in order to improve the future provision of AECPGs in Europe, several new approaches are proposed (European Network for Rural Development, 2022; European Parliament and the Council of the European Union, 2021). These include changes that can be observed in both public and private contract solutions fostering (1) result-based payments, (2) collective implementation of AECM, or (3) a market-based remuneration of public good provision involving the value chain. Result-based payments, i.e. rewarding for achieving a prior defined ecological status or environmental objective rather than the carrying out of specific management practices (or prescribed actions), might enhance the effectiveness and efficiency of money spent (Burton and Schwarz, 2013; Chaplin et al., 2021; Wuepper and Huber, 2022). Such schemes might also support the wish for higher flexibility in management decision-making among farmers (Chaplin et al., 2021; Herzon et al., 2018; Sabatier et al., 2012) and provide a better possibility for innovation (Allen et al., 2014). Incentive schemes funding the collective implementation of AECMs are directed towards groups of farmers and might be suited to target more comprehensive AECPGs provision on a landscape scale. Such solutions could particularly provide spatial approaches for tackling landscape-scale environmental problems, such as habitat fragmentation, water pollution, and soil erosion (Tyllianakis et al., 2023; Westerink et al., 2017). Within the CAP Strategic Plans Regulation ((EU) 2021/2115), Article 70 (5), member states are encouraged to stimulate and endorse collective arrangements and result-based payment schemes as means of motivating farmers or other beneficiaries to deliver substantial advancements in environmental quality on a larger scale or through quantifiable means (European Parliament and the Council of the European Union, 2021). Moreover, private, market-oriented mechanisms, such as payments for ecosystem services, labeling, certification or tradeable rights and permits, might be suited to overcome some limits of public funding (Pirard, 2012). Particularly contracts along the value chain could supplement public funding in securing and increasing the sustainable production of agricultural commodities and non-commodities (European Network for Rural Development, 2022).

Although some EU member states have already introduced result-based and collective arrangements in the 2023–2027 CAP period, such new approaches are scattered and not yet implemented at scale (European Commission, n.d.; Huber et al., 2025; Sander et al., 2024). Thus, the design of such novel schemes is mainly based on large-scale information and theoretical assumptions. Complementary, practical, and locally tailored information is needed to support the design of such contracts and their integration into comprehensive contractual solutions for public good provision.

So far, many studies analyzing the design of novel AECM have focused on individual instruments (Hagemann et al., 2025; Limbach, 2024), specific public goods, e.g. biodiversity (Birge et al., 2017; de Sainte Marie, 2014; Derissen and Quaas, 2013; Schaub et al., 2025; Zabel and Roe, 2009) or on a single country (Alblas and van Zeben, 2023; Chaplin et al., 2021; Harmanny et al., 2025; Schaub et al., 2025). Broader studies that include multiple contract types, public goods, and countries have primarily been conducted as literature reviews, focusing on the ex-post inductive derivation of factors contributing to success or failure (Bredemeier et al., 2022; Burton and Schwarz, 2013; Olivieri et al., 2021). Also, studies that focus their analysis on real-world examples exist, for example, the study of Sattler et al. (2023). The value of our study lies in the systematic examination of real-world examples of three novel contract types, drawing on a large number of cases from 13 European countries and thereby focusing the analysis on the contract solutions, their design characteristics, and the interplay among these features within comprehensive contract solution arrangements. This results in the following three research questions (RQ): RQ1 Which novel types of contracts exist in practice, and how do their design features compare? RQ2 How are these new forms of contracts embedded in full contract solutions arrangements available for land managers

(institutional setup), and RQ3 which characteristics (performance features) particularly contribute to their success and longevity?

By adopting a systemic perspective, we account for the interplay between individual contract characteristics and their combinations, with a particular focus on innovative approaches including hybrid solutions (combinations of different contract types), thereby providing a more holistic understanding.

Our analysis concentrates on 44 case studies from across Europe, consisting of result-based contracts, contracts involving collective implementation, and market-based contracts. Data was collected using a standardized protocol, involving national actors responsible for the case studies. Through qualitative content analysis, we identified both specific and general characteristics. This approach enabled us to identify patterns and interdependencies of contract solutions that have not been systematically examined in prior research. The insights derived from our analysis contribute to developing evidence-based policy recommendations, providing practical guidance for the future design and implementation of alternative voluntary AECM.

2. Material and method

2.1. Methodological approach

To analyze the design of novel AECS, as well as the characteristics fostering success and longevity, we used a case study research strategy with multiple cases (Stake, 2005). Well-established in social science, including political science and economics research (Yin, 2003), case study research presents a long-standing approach complementary to econometric modeling and other quantitative approaches, both in agribusiness and agricultural economics (Flyvbjerg, 2011; Kennedy and Luzar, 1999). Prominent fields of application are analyses beyond the farm gate, such as local environmental case studies, policy case studies, or agribusiness management case studies. Based on Robson, (1993), p. 146, a case study is "A strategy of doing research which involves an empirical investigation of a particular contemporary phenomenon within its real-life context using multiple sources of evidence." In our case, the focused phenomena are novel contract solutions implemented in Europe. For clarity, a *contract solution* extends beyond the contract itself and includes the preparatory phase (meetings, training, etc.) as well as potential support and management activities (Langlais et al., 2022). The contract itself concerns the legal relationship between the parties and, in our case, constitutes an agreement on the delivery of AECPGs, which is usually linked to a payment.

All contract solutions under investigation involve at least one of those three *contract types:*

- *Result-based (RB) contracts*: Contracts specifying an environmental/climate result as the reference parameter (for payments).
- *Collective (CO)* implementation*: Contracts* implementing cooperation among farmers/actors to provide AECPGs for joint payment.
- *Value chain-based (VC)* contracts*:* Contracts connecting the provision of AECPGs with the production of private goods for which the land manager receives a premium.

Our case-study approach offers several benefits: It enables us (i) to capture the contract solutions within their wider context (i.e. the agricultural system, the environmental system, climatic conditions, etc.) (Kennedy and Luzar, 1999) and thereby gain detailed and contextualized understanding by also considering its complexity (Yin, 2018); (ii) to get a deeper insight into the design of contract types and solutions in practice (Flyvbjerg, 2006); and (iii) to gain broader insights based on a rich data set by including information from e.g. interviews, reports, homepages, workshops (Stake, 1995).

The analysis of the case studies was based on a common framework developed by Viaggi et al. (2020), which has been more deeply described by Targetti et al. (2024) and further adapted and illustrated by D'Alberto et al. (2024) (see Fig. 1). The framework brought together different aspects of contract solutions, drivers, farm and context variables, highlighting the interplay of three main elements: contract design, system features, mechanisms and impact. The contract design includes objectives, duration, and payment levels while the system features address broader aspects such as governance, market conditions, and local environments influencing contract solutions. Mechanisms and impact focusses on factors like governance and farmers' attitudes that influence the contract's success. Finally, the framework embeds performance criteria like acceptance, longevity, and profitability, which are affected by farm-level and regional factors and are interconnected with the other elements. This comprehensive approach ensures systematic consideration of both the design and contextual elements that shape contract solutions. In our study, we examined one element in particular: the contract design features, their presence in the real case examples of contract solutions, and their impact on performance.

For the analysis of the case studies, we used a mixed methods approach (see Fig. 2). After defining the research question, we selected case studies across Europe based on predefined selection criteria. Considering the literature and the aim of guaranteeing a uniform and structured process of data and information collection, we developed a protocol of data collection which was applied to the selected case studies. Collected data was then analyzed in two ways: a quantitative approach was used to describe the cases (presented in chapter 3.1), while a qualitative content analysis was conducted to gain in-depth insights into the design of the contract types and solutions as well as their characteristics fostering successful implementation (presented in Chapter 3.2).

2.2. Case studies selection and data collection

To select case studies, we applied an information-oriented selection strategy, meaning we selected cases according to the information content expected from them (Flyvbjerg, 2006). Thereby, we used the following criteria: First, case studies needed to represent one of the three selected contract types. Second, case studies had to target the provision of one or more out of 14 predefined AECPGs (derived from Cooper et al. 2009, see Appendix A, Fig. 2). Third, the respective contract solutions needed to be existing and successfully implemented, whereby also pilot projects have been accepted. A contract solution has been classified as successful, if it is "environmentally effective", which means it reports improvement of AECPG's (in the best case, long-term improvements). Moreover, case studies were included if AECPG's improvements did not become apparent yet (e.g. due to short running time of the program etc.), but were foreseeable (Eichhorn et al., 2020). The national research groups decided on classifying a contract solution as success. Those indicated as a failure were excluded from this study. Fourth, we aimed for maximum diversity regarding types of contract partnerships (public-private, private–private, civil society–private, public-private–civil society), types of agriculture/forestry systems (grassland, permanent crops, arable land, continuous cover forestry, drained peatlands), and geographical locations. In the end, 13 European countries contributed with case studies, namely Austria, Belgium, Bulgaria, Germany, Spain, Finland, France, Ireland, Italy, Latvia, Netherlands, Poland, and the United Kingdom. Within these countries, case studies were selected by national research groups supported by experts and stakeholders mainly from the field of agri-environmental programming (based on workshops or bilateral exchanges). This resulted in a final set of 44 case studies with two to five case studies per partner country (a table including case studies, location, and involved research team is available in Appendix B).

To guarantee a uniform and structured process of data collection, and to warrant the comparability of cases, a protocol of data collection containing a standardized questionnaire was applied. The protocol included 33 open and 6 closed questions, organized into 7 thematic sections. Open questions were answered in the format of short

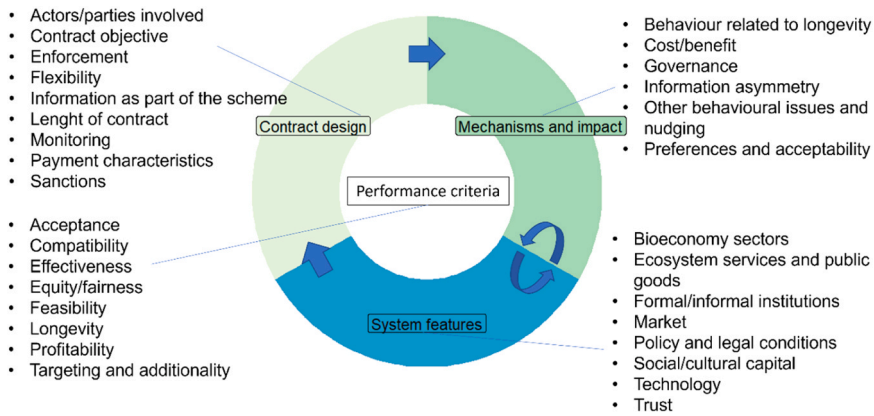

Fig. 1. Analytical framework for the analysis and design of agri-environmental and climate contracts, developed by Viaggi et al. (2020) and illustrated by D'Alberto et al. (2024).

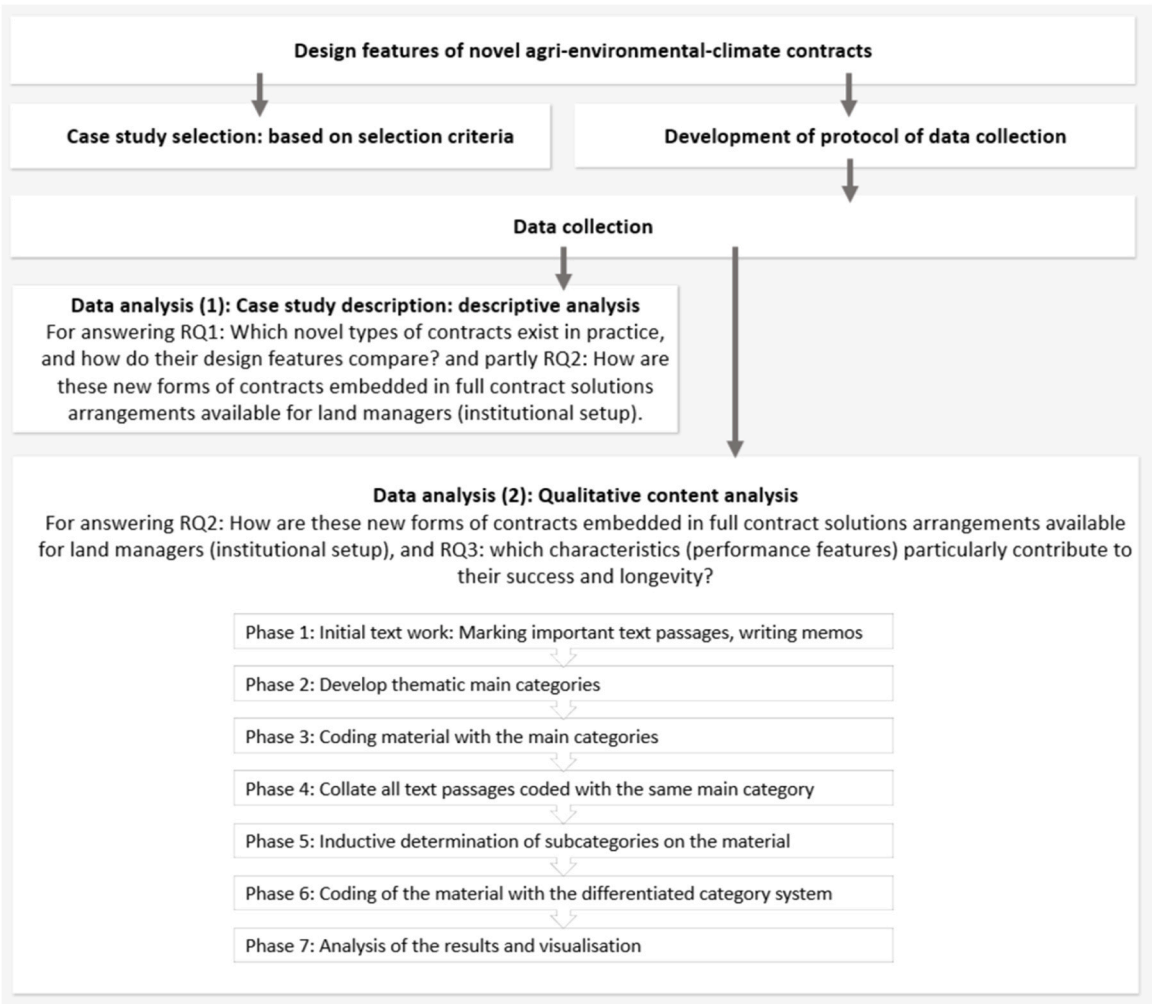

Fig. 2. Overview of the methodological approach.

descriptive texts and closed questions by choosing from lists of predefined options. The protocol of data collection itself was literature-based and structured along the topics: (i) background information of the case study including problem statement, objectives, and AECPGs addressed; (ii) contract features involved, such as contract type and form of partnership, participation/number of participants, contracting parties, start/end, renewal/termination, contract conclusion, contract length; (iii) system of payment, including financing party, payment mechanism, and payment modalities; (iv) conditions of participation; (v) requirements for farmers/foresters, and risks/uncertainties of participants; (vi) context i.e. location, climate and landscape, and farm/forestry system targeted. In addition, (vii) an evaluation of the contract solution in the form of a SWOT analysis was asked for each case study, describing its main strengths, weaknesses, opportunities, and threats.

Finally, (viii) a short summary of the main reasons for the success of the case study was included. After pre-testing the protocol in two case studies (one RB and one VC case), it was finalized. The detailed protocol of data collection is included in the supplementary material (Appendix A).

Data collection was carried out by the countries' research teams through a series of interviews and workshops complemented by information from mainly grey literature (project/research reports, homepages, etc.). In total, 76 actors involved in case studies were reached, including case study leaders/managers or coordinators, participating farmers/foresters, project employees, scientists/advisors accompanying the case study, consultants/experts from NGOs, etc. For the reporting of results, a reporting template filled out individually for each case study was programmed in LimeSurvey (Version 5.4.3). The collected data was then directly transmitted to the lead authors.[1]

2.3. Case studies analyses

We followed a two-step approach: We first analyzed the collected data descriptively according to specific contract features (e.g. contract types, AECPGs targeted, contracting parties, etc.) followed by a Qualitative Content Analysis (QCA) according to Kuckartz and Rädiker (2022). The QCA was developed after Rudel (2008) which adapted it from Ragin (1987). Kuckartz and Rädiker (2022) based their method for conducting a QCA on Mayring's work (Mayring, 2014), but their approach allows for greater flexibility and is more geared towards the use of software. At the core of QCA are categories that are used to code all material relevant to the research question(s). The approach is predominantly qualitative, though it can also incorporate quantitative-statistical analyses. We conducted a content-structuring QCA, by building main and subcategories in a hierarchical system (Kuckartz and Rädiker, 2022). Thereby, we followed the seven phases of Kuckartz and Rädiker (2022): In phase 1, representing the initiating text work, we classified the cases regarding their contract type. In phase 2, we developed the main thematic categories. Once the code set including its main categories was developed, in phase 3, we tested it by analyzing one exemplary case study of each contract type and modified the code where necessary. In phase 4, all text passages belonging to the same main categories were collated. In phase 5, subcategories were developed focusing on the specificities of each contract type. Upon reviewing the coding system, a final coding frame with 18 main categories and 59 subcategories was derived (the coding frame can be found in Appendix C). A second coding phase with two passes using the revised deductive-inductive coding system was then applied across all 44 case studies (phase 6). Data coding was technically supported by the qualitative data analysis software "Atlas.ti". Finally, we described and interpreted our results under consideration of our second and third research question on how these contracts are embedded in full contract solutions, and which characteristics (design features) particularly promote their success and longevity, which resulted in the derivation of specific contract characteristics for each contract solution (phase 7).

3. Results

3.1. Descriptive results of the case studies analysis

To answer RQ1 - namely, what new types of contracts exist in practice and how do their design features compare – and partly RQ2 - how are these new forms of contracts embedded in full contract solutions arrangements available for land managers (institutional setup) - we conducted a descriptive analysis of the collected case studies based on specific contract characteristics (e.g., contract types, target AECPGs, contracting parties, etc.), and there institutional setup and compared them across contract type groups.

Each case study has been screened for the dominant contract type element and has then been assigned to the respective contract type group. Out of the 44 case studies in the sample, 17 represent result-based contract solutions (RB), 16 collective implementation (CO), and 11 value chain-based approaches (VC).[2] 19 cases combine elements of different contract types and are defined as "hybrids". Hereby, RB with CO elements is the most frequent (7 cases), followed by hybrids of VC with CO elements (6 cases). The number of participants in the individual contract solution shows broad variability, ranging from pilot projects with only a few participants to solutions with over 700 participants. However, on average, cases tend to be of modest participation size and are characterized by an experimental nature (see Table 1 in Appendix D). Most contract solutions show a strong regional link: 33 of the 44 case studies, including all CO contract solutions, are targeted at a specific region or area. 36 contract solutions were specifically developed for agriculture and 8 were developed for forestry. For all three contract types, at least one forestry case study is present in the sample.

All 14 AECPGs targeted in the study were directly addressed by at least one case study (Table 1). A distinction between direct and indirect addressing of AECPGs by contract solutions is made in the case studies. AECPGs are considered "directly addressed" only when the contract solution specifically targets their maintenance or improvement. On the other hand, if the improvement of AECPGs is a side effect of the measures taken, they are deemed "indirectly addressed". Thereby, across all contract types, number 2 "(farmland) biodiversity/habitats" was the most frequently addressed AECPG (31 cases), followed by "Landscape and Scenery" (12 cases), both targeted by all three contract types but most frequently in CO contracts. "Water quality" is ranked third and this AECPG is most frequently addressed by CO contracts. Also, the landscape level AECPG "resilience to natural hazards" is predominantly covered by CO contracts. The more complex social AECPG "rural viability and vitality" is addressed both by CO and VC contracts. The AECPG "quality and security of products" is specifically focused by VC contract solutions. Finally, we observed that RB schemes primarily focus on the provision of only one or two AECPGs (with an average of 1.6 AECPGs addressed), whereas CO approaches address broader bundles of AECPGs (with an average of 3.4).

Comparing the three contract types in terms of partnership, all VC contracts only involve private partners (see Fig. 3). In contrast, CO contracts are mostly agreed between public and private partners (13). In several cases, civil society is also involved (6). As regards RB contract solutions, 13 contracts are concluded between private and public partners, and 6 contracts involve private-private partnerships.

Concerning funding sources, all but one CO contract in our sample relies on public money while the VC contracts within the sample are financed via the market except for one contract that received government support for communication and project activities. In contrast, RB contracts show more heterogeneity and are almost equally funded by both public funds with and without EU contribution and private sources (Fig. 4). Most CO contracts are part of the countries' rural development programs (RDPs) and therefore co-funded by the EU under EAFRD, the European Agricultural Fund for Rural Development (Fig. 5) (see Appendix D for in-depth descriptive case study information).

[1] Factsheets with the compiled information are already published within the CONSOLE project and can be accessed on an online platform https://www.console-hub.eu/

[2] A list of all case studies involved is available in the Appendix B.

Table 1
Public goods addressed directly in the case studies according to result-based, collective and value chain-based contract types.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
RB	3	11	2	2	1	1	2	1	0	0	2	2	1	0
CO	6	13	6	4	1	1	3	2	2	0	7	2	6	1
VC	3	7	3	1	1	1	4	0	3	4	0	0	0	0
SUM	12	31	11	7	3	3	9	3	5	4	9	4	7	1

Contract types: RB = result based; CO = collective, VC = value chain; Public goods: 1 = landscape and scenery, 2 = (farmland) biodiversity/habitats; 3 = water quality; 4 = soil quality (and health); 5 = climate regulation – carbon storage; 6 = climate regulation – greenhouse gas emissions; 7 = rural viability and vitality; 8 = water quantity; 9 = farm animal health and welfare; 10 = quality and security of products, 11 = resilience to natural hazards; 12 = recreational access/improvements to physical and mental health; 13 = cultural heritage; 14 = air quality.

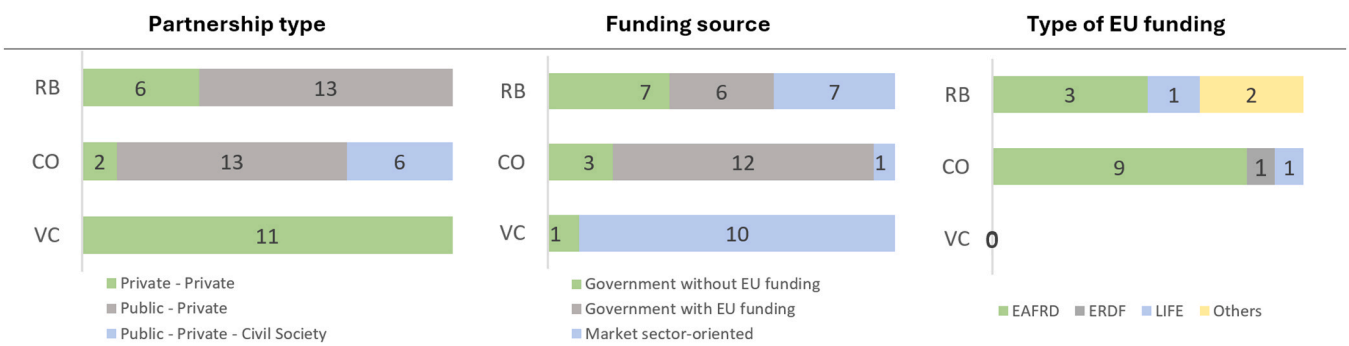

Fig 3: Partnership within each contract type **Fig 4: Funding source within each contract type** **Fig 5: Type of EU funding within each contract type**

Fig. 3;4;5. Partnership; Funding and Type of EU funding: Contract types: RB = result based; CO = collective, VC = value chain; Type of EU-funding: EAFRD = European Agricultural Fund for Rural Development, ERDF = European Regional Development Fund; Multiple answers are possible.

3.2. Design features of novel agri-environmental contracts

The QCA of the case studies revealed that existing result-based, collective, and value chain-based contract solutions are characterized by specific design features that contribute to their success.[3] This chapter, therefore, provides an answer to RQ3 - which characteristics (performance characteristics) contribute most significantly to their success and longevity. Together with Chapter 3.1, it also partly addresses RQ2 - how are these new forms of contracts embedded in full contract solutions arrangements available for land managers (institutional setup).

3.2.1. Features specific to result-based contract solutions

For result-based contract solutions (case studies A1 to A17), we identified five design features impacting success, namely the specific means of measuring results, features to support knowledge, features enhancing farmers' flexibility, features supporting the enhancement of social and cultural capital, and, finally, the use of result-based elements in hybrid approaches, integrating features of other contract types (see Table 2).

Means of AECPGs result measurement (RB1): In RB contract solutions, payments depend on the achievement of AECPGs objectives, assessed through appropriate indicators and associated methodologies. The measurement of AECPGs results is, therefore, the key feature of RB contract solutions. QCA analysis revealed a sub-categorization of the measurement feature into four main approaches: (i) direct indicator-based measurement of AECPGs provision, (ii) scoring and point systems linked to AECPGs delivery based on indicator sets, (iii) assessment of key performance indicators (KPIs) out of data existing at farm or forestry business, and (iv) measurement of AECPGs provision by indirect indicators. In our sample, two RB cases *directly measure and reward absolute changes* in AECPGs indicators: In case study A6, methane emission reduction from dairy cows is assessed through the analysis of milk's fatty acid composition during regular milk analysis. Being directly linked to methane emissions, the composition of milk's fatty acids can be influenced by farmers via feedstock adjustments. In case study A2, focusing on carbon sequestration, plot-wise changes in soil humus content are measured by GPS-supported sequential soil sampling and quantified with standard soil analysis methods: being directly linked to the amount of CO_2 sequestered, which then serves as the basis for payments to farmers, increases in humus content can be achieved by farmers via changes in soil management. The two examples show that direct measurement of AECPGs indicators provides immediate control over actual AECPGs provision and high efficiency of payments; however, it places high demands on the indicators and the monitoring processes. On the one hand, indicators must show absolute changes in the AECPGs addressed. On the other hand, they need to have a causal relationship with and, as a consequence, react to changes in agricultural management practices. In our examples, however, indicator measurement via

[3] Each case study has a clear identification. Case studies with result-based contract solutions start with the letter "A" and are then numbered from 1 to 17. Collective contract solutions start with "B" and are numbered from 1 to 16, while value chain-based contract solutions start with "C" and are numbered from 1 to 11. All case studies with their ID can be found in Appendix D.

Table 2
Performance features found within result-based contract solutions.

Result-based contract solutions – performance features	
Means of AECPGs result measurement (RB1)	– Direct measurement of AECPGs performance by specific indicators – Scoring and point systems linked to environmental outcome/ delivery – Assessment of Key Performance Indicators (KPIs) out of data available at farm level – Indirect measurement of AECPGs provision
Knowledge provision (RB2)	– Advice (farm advisor, ecologist, etc.) – Training (initial training, theoretical or practical training) – Educational principles and material (guidelines, factsheets, …) – (Technical) supporting tools (smartphone tool, documentation app)
Degree of flexibility (RB3)	– Flexibility in the choice of measures to be implemented – Free to decide when to undertake management practices (e.g. mowing) – Flexibility in the area/field/plot involved in the contract solution – Farmer/forester-centered approach (objectives, local situation; contract details incl. variable contract duration)
Building of social and cultural capital (RB4)	– Learning by doing and observing – Social components (network, exchange) – Environmental rewards, awards
Hybrid solutions (RB5)	– Combination with action-oriented schemes and collective approaches – Market-orientation, input to Corporate Sustainability Reporting (CSRD)

milk and soil analysis conducted by a laboratory has been perceived as easy to implement (A6) and understandable for farmers (A2). Direct measurement can also support longevity as it can produce time series monitoring success and enable long-term analysis. This is evidenced in A2, where GPS-supported soil sampling is conducted regularly over more than seven years, providing ongoing insights. *Scoring systems*, as developed and implemented in RB solutions in Ireland (A7, A12, A14) and France (A11), translate the status of AECPGs provision into scores expressing the overall quality of the agricultural ecological system (e.g. habitat/biodiversity quality). In our examples, scores are based on the monitoring of specific sets of indicators, with different threshold values of level of provision (e.g. numbers of or extent of area covered by different positive/negative indicator plants). Also in scoring systems, demands on the indicators and the monitoring processes are high, while some design features can ease implementation and transferability: e.g. in A7 and A14, scoring systems have been developed for individual habitats, such as species-rich floodplain meadows, using habitat-specific score cards, which define positive and negative indicators for the respective habitat type. Often, scoring systems function as the basis for tiered payments, linking levels of payments to predefined levels of scores reached. Here, the financial risk for farmers is reduced, breaking away from an all-or-nothing approach (A7). An approach of simplified monitoring are RB payment systems based on *Key Performance Indicators*. Rather than measuring the real provision of the AECPGs targeted, KPIs measure the basic requirements for their provision and are normally linked to existing data sets or data that is easy to collect by farmers or foresters. Our case study sample contains two KPI-based RB solutions: In A15, fostering biodiversity in dairy milk systems, the share of a farm's permanent grassland area, the share of protein produced on the own farm or within the region, soil nitrogen surplus (kg/ha), the share of nature conservation management area and landscape elements are used within a set of biodiversity KPIs. In A16, fostering biodiversity in arable farming and being in a pilot phase, suggested including data on fertilizer inputs, soil management, and landscape elements on the farm as KPIs. In general, the assessment of KPIs reduces monitoring efforts and administrative burdens. Nevertheless, to be effective, KPIs and their target and threshold values need to guarantee a (scientifically) proven link to the AECPGs addressed, and to be influenced by management measures in the short term. The last means of measuring AECPGs provision in RB contracts is the use of indirect indicators. In contrast to direct measurement of AECPGs results, second-order indicators such as the number of visitors as an indicator for the AECPGs of landscape and recreation (A10), the implementation of monitoring activities (A3, A4), or the proven fulfillment of one-shot tasks of improvement like scrub clearance (A4, A9, A17) are the basis for payments. The case studies utilizing indirect indicators indicate that the approach allows for flexible management (A3, A9, A10), it is straightforward to implement (A3), and it is less demanding for land managers than alternative forms of AECPGs measurement.

Knowledge provision (RB2): Most RB case studies include design features of *knowledge support* (10/17). Means of knowledge provision are (i) advice, (ii) training, (iii) educational material, and (iv) supporting tools. In six RB case studies, personal advice is given by nature protection advisors or ecologists assessing farms/fields, identifying valuable species, and discussing existing deficits and solutions with farmers (A1, A3, A5, A9, A12, A14). As regards training, in one case study, it contained practical and theoretical training, with classroom sessions supplemented by field training to help farmers in measurement and goal attainment (A7). Additionally, educational materials, including individual logbooks, were provided in 5 cases (A1, A2, A3, A8, A15). Specific support tools, such as technical or online support, were utilized in two case studies (A1, A6). Knowledge support is perceived to have a pivotal role in the successful implementation of RB contracts. The main advantages are thereby to increase participants' understanding of the causal links between management and AECPGs provision, to support them in the implementation, to reduce the perceived complexity of new and unfamiliar contract solutions, and, finally, to promote exchange between participants. The high level of support is a factor that contributes to success; however, it can also be a significant financial burden. Several case studies have identified high costs, particularly for environmental advice, which presents a challenge to the feasibility of larger-scale implementation (A8, A1, A14).

Degree of flexibility (RB3): In most RB case study examples, a high degree of individualization and flexibility becomes obvious. The investigated contract solutions broadly enable land managers to choose when (7/17: A1, A2, A3, A6, A7, A9, A14), which management practices (6/17: A1, A2, A3, A5, A7, A14), and on which fields/areas (9/17: A1, A2, A3, A6, A7, A8, A9, A12, A14) AECPGs provisions are implemented. In addition, most case studies implement a farmer-centered approach by developing farm or site-specific targets (9/17: A1, A2, A3, A4, A6, A8, A9, A12, A14), adapting measures to the farm and the local situation (13/17: A1, A2, A3, A4, A5, A6, A7, A8, A9, A10, A11, A12, A14), as well as enabling farmers to have a say in the development of the contract itself (6/17: A1, A4, A7, A9, A12, A14). The flexibility and the prevailing absence of management rules and requirements are stated to be a core factor raising the acceptance of RB contracts among farmers (e.g. A2, A6).

Social and cultural capital (RB4): Many RB cases include features suited to increase both social and cultural capital. Thereby, learning by doing and observing (6/17: A1, A2, A7, A9, A12, A14), the inclusion of social components (network, exchange) (4/17: A2, A7, A10, A12), and rewards and awards (3/17: A2, A8, A12) were identified as important. The building of social and cultural capital was highlighted most frequently in RB case studies, and several cases explicitly mentioned it as a reason for success (A1, A2, A7, A3, A12, A14). As regards specific features, in A14, learning by doing was perceived to increase the engagement of farmers, as not only are conservation practices demonstrated in real life, but also their positive effects on agricultural efficiency and performance are highlighted. A1 reported that learning by doing leads to a better understanding of farmers in the connection between their actions and the influence on nature if they record AECPGs results of their self-chosen management in the fields. A notable example

of the integration of social components into the contract solution was found in A2, where a network among partaking farmers, a so-called 'Humus community', is established for regular information exchanges and mutual support. Also, awards are used to promote participation via the generation of role models and pride, e.g. in A2, farmers who build up humus are honored during a well-known agricultural event. This public recognition is estimated to encourage other farmers to participate, while the humus farmer is motivated to continue. Building social capital via RB solutions can also reach beyond the level of the farming community: one of the Irish RB examples (A12) is widely recognized outside the region and its innovative approach is copied elsewhere, at the same time it is perceived to have united the local community and generated goodwill and pride in the area.

Hybrid solutions (RB5): Most of RB cases in our sample combines the RB approach with features of other contract types (13/17: A1, A2, A5, A6, A8, A9, A10, A11, A12, A13, A14, A15, A16). Three RB case studies are hybrids with action-based measures (A1, A12, A14). In A12 and A14, participating farmers are rewarded for their environmental performance (based on a scoring system) while also having access to a fund compensating self-nominated 'conservation support actions' (e.g. planting hedgerows). A1 represents a combined system: (1) specific environmental targets guiding the farmer in his/her management (results-oriented) and (2) management criteria used by the national control service as indicators which must be met by farmers for issuing the payment (action-based). The combination of the RB component with action-based payments enables a better risk distribution for the partaking farmers due to guaranteed payment for measure implementation while still being perceived to enhance habitat quality. It paves the way for the inclusion of RB contracts in agri-environmental programs while simplifying the control. Moreover, several RB cases are combined with market-based remuneration, and therefore engaging private funding (A2, A6, A8, A9, A10, A15, A16), e.g. by means of (CO_2) certificate trading to companies and private actors (A2, A6, A15, A16). The activation of private funding alongside public funding bears the risk of double funding, which was mentioned as a threat/weakness in several case studies (A7, A12, A13, A14, A17), including when solutions are implemented as pilot projects (e.g. A7).

3.2.2. Features specific to contract solutions fostering collective implementation

Contract solutions fostering collective implementation (case studies B1 to B16) organize and implement efforts to reach AECPGs objectives beyond the farm/field/plot level. The landscape-oriented approach in collective contact solutions addresses issues such as habitat fragmentation, maintenance and restoration of ecological networks (B10, B11), flood risk mitigation (B2, B4, B5, B7), or improvement of the water quality in catchment areas (B1, B6, B9). Our case studies show that collective approaches have been introduced when individual contracts have failed in delivering specific AECPGs (B8, B14) or when there was a desire amongst actors to tackle environmental problems collectively (B2, B5, B7). This was, for example described in B8: *"[…] target species required a larger mosaic of land use and land cover than can be provided on a single farm"*. The QCA has identified five specific contract design features, namely the degree of formalization, the kind of common management agreement, the inclusion of a coordinator, the composition of the group, and means of meeting and exchange, which characterize CO contract solutions (see Table 3).

Degree of formalization of the group (CO1). The 16 practice examples reveal that CO solutions can be implemented with varying degrees of formalization between the contracting partners: In strictly collective contracts, land managers voluntarily enter a joint, collective partnership to deliver specific AECPGs commonly. This means that farmers and foresters (and other actors) cooperate by setting up an organization with a legal entity (e.g. association) or by involving an existing coordination body (e.g. NGO) to define and implement measures for achieving a specific (AECPGs) objective. This entity commonly applies for funding e.g. through agri-environmental programs. Payment for management activities is then provided to the entity that distributes the payment to the participants (B3, B7, B8, B12, B15, B14, B16). The entity then (sub) contracts group members individually (B8, B15, B16). In approaches without formal entity, land managers contract individually although activities are agreed within the group, potentially involving other local stakeholders to meet commonly agreed goals. Normally, such forms of collectives also lack the feature of collective payments (B1, B2, B4, B5, B6, B11, B13). Such collectives are often more loosely facilitated through a local key person.

Table 3
Performance features found within collective contract solutions.

Collective contract solutions – performance features	
Degree of formalization of the group (CO1)	– Formalized collective entity/No formal collective entity – Collective payments – Individual payments
Inclusion of a coordinator (CO2)	– With (external or a group member) / without – Tasks of the coordinator
Enabling common management (CO3)	– Common goal/vision – Nature management plan – Catalogue of measures – Collective management requirements
Group composition (CO4)	– Exclusively farmers / foresters – Involvement of NGOs, other local actors – Farm characteristics – Attitudes
Knowledge diffusion and exchange (CO5)	– Settings of the meeting – Peer-to-peer exchange – Group bonding and networking

Inclusion of a coordinator (CO2): QCA analysis showed that normally three main parties are involved in CO contract solutions, namely land managers, funding bodies, and a coordinator (B1, B2, B4, B5, B6, B8, B12, B15, B16). Hereby, the coordinator plays a fundamental role and can be an external person or a member of the entity, for example, described as "facilitator" (B1, B2, B4, B5, B6), "intermediary" (B14), "leading subject" (B7) or "managing authority" (B3). The coordinating party fulfills multiple tasks such as recruiting farmers (B1, B2, B4, B5, B6, B14, B15, B16), organizing meetings, managing communication (B1, B2, B4, B5, B6, B14), guaranteeing compliance (B7), coordinating and specifying operations (B7, B8, B9, B14), applying for and distributing funding (B15, B16), and providing coaching and technical support (B11). The involvement of a suitable coordinator has various benefits. They promote active participation (B7, B14), enhance trust (B12), simplify the administration for participants, thus reducing transaction costs (B8, B11, B12), and support knowledge transfer (B1, B11), resulting in an increased commitment among the land managers.

Enabling common management (CO3): To reach the objective of delivering AECPGs on a larger scale, CO solutions are usually based on a common management agreement (B7, B8, B9, B12, B14). CO contracts are often based on (regional) nature management plans, providing precise measures to be taken to achieve concrete environmental benefits (B11, B12), a catalog of measures to which farmers can refer (B8), or collective management requirements are defined (e.g. "*at least 26% of the area of the collective zone must be dedicated to crops favorable to the European Hamster*") (B14). In B12, every private landowner within the association signs an agreement in which he/she agrees that certain actions may be carried out on his/her territory and that he/she also makes the necessary preparations to ensure that these actions can be carried out well. Well-defined management agreements foster acceptance among farmers. It was stated that they enhance trust (B12) and ensure landowners and managers know that their objectives for the land are acknowledged and clearly outlined in the agreements (B11). Also, they can enhance efficiency due to the inclusion of local knowledge, enabling better targeting of actions and payments (B14).

Group composition (CO4): The group's composition is a factor

contributing to success. In our cases, it has been described as advantageous if the group is rather homogeneous and has similar characteristics, for example, in terms of farm size, farming specifications, and farming practices (B2). Furthermore, shared attitudes towards environmental issues, common goals, and a unified vision are also perceived as conducive to success (B1, B3, B6, B12, B13). Conversely, several CO cases illustrate that the common implementation of measures is particularly challenging when differing interests exist (B2, B3, B11). There must be a positive climate of cooperation and trust between the participants (B7), as well as an awareness of the environmental problem (e.g. poor water quality), which should be addressed collectively (B6).

Knowledge diffusion and exchange (CO5): Network and community building often serve as integral components of collective solutions and are typically achieved through regular meetings. These meetings primarily emphasize strengthening group bonds and networking (B5, B11), along with facilitating peer-to-peer exchanges where participants discuss various practices and learn from each other (B2, B4, B5, B13, B14). Furthermore, the social aspect of meetings/exchanges is perceived to motivate more farmers to participate (B5, B11). One case stated that *"The contract solution facilitates meetings between, and training of, land manager members and is focused on increasing the probability of delivering higher quality environmental public goods through better environmental management and by supporting knowledge transfer."* (B1). The meetings in our case studies were scheduled with varying regularity. In some case studies, group members meet monthly (B1, B4, B5), while others meet irregularly or on specific occasions (B13, B14).

3.2.3. Features specific to contract solutions along the value chain

In contract solutions with involvement of value chain partners (case studies C1 to C11), the provision of public goods is tied to the provision of private, marketable goods. For successful VC contracts, the QCA has identified five core performance features, namely the type of relation between the production of private goods and AECPGs, the types of VC incentives provided to producers, the characteristics of the value chain itself, the means of marketing and, finally, the integration of collective features into the contracts (see Table 4).

Relationship between private good production and AECPGs provision (VC1): In our sample of 11 VC case studies, AECPGs improvements are mostly coupled with the production of individual, marketable products (honey (C1), meat (C2, C3), crops (C4, C5, C10), rice (C6), wine (C7), bottled water (C8); olives (C9)). Thereby, AECPGs provision or improvement happens through fulfilling environmental requirements during production, such as meat production with higher animal welfare standards (C2, C3), or arable production implementing water protection (C5) or biodiversity-friendly management practices (C4). In some cases, products are involved that have specific attributes, such as rare breeds (C2) or rare or old crop varieties (C10), and thereby directly address also the public good of quality and security of products. Also, VC solutions targeting specific sustainability attributes often build upon already existing higher production standards, such as organic production, adding even stricter requirements (C1, C6, C7, C10). The right scale for setting producer requirements has been perceived as a balancing act in VC contracts: To gain consumers' trust, on the one hand, production rules and environmental requirements in VC contracts must be strict, transparent, and controllable. On the other hand, implementing them must be feasible for the producers. Solutions to this challenge are seen in participatory processes, where conditions of participation are commonly defined and agreed between all stages of the value chain (e.g. C5, involving farmers, mills, and bakeries) or by the integration of a "neutral" research partner in the development of the contract solution (C4, C3). As regards the control of requirements, to create trust for both producers as well as consumers, several cases use independent third-party control authorities (C3, C4, C8), while in C5 control and monitoring are taken over by a research institute and the public water suppliers.

Table 4
Performance features found within value chain-based contract solutions.

Value chain-based contract solutions – performance features	
Relationship between AECPGs and private good production (VC1)	– Type of private good – Type of public good – Environmental standards: Existing certification standards (e.g. organic farming)
Incentive system (VC2)	– Price premium – Purchase guarantee
Value-chain characteristics (VC3)	– Stages included – Regionality
Marketing (VC4)	– Branding – Communication strategy – Highlighting of additional product qualities
Collective element (cooperation in VC contract solutions) (VC5)	– Bargaining weight – Production benefits – Networking and knowledge sharing

Incentive system (VC2): VC-based contract solutions are mostly independent of public funds and usually financed by the purchaser of the product. QCA revealed two major incentives for producers participating in VC contract solutions: One is the realization of higher profitability via higher product prices for fulfilling additional environmental requirements (C1, C3, C4, C6, C8, C9, C10). In one case (C10), where the acceptance among farmers is particularly high, it was stated that "*Farmers get a good price for the cereals.*". However, relying on private money was stated to bear risks in some cases, namely that premium prices cannot always be guaranteed by the market (competition e.g. due to import; consumers' low willingness to pay; dependence on demand) (C1, C6, C9, C4, C10). A second major incentive for producers is sales guarantees, which are explicitly provided in four cases (C4, C5, C7, C10). It was stated that such guarantees, even if not combined with premium prices, increase acceptance on the farmers' side as they minimize production risks.

Value chain characteristics (VC3): Our sample's VC solutions show a large variety as regards the stages of the chain included. Some solutions represent distinctively short chains (C3, C10). In one case sole seller-buyer relationships involved only two actors (producers and processor) (C3,) and other VC contract solutions cover all downstream stages of the chain, starting from the producing farmers to the storages, processors, retailers and finally marketing initiatives targeted at the consumers (C2, C4, C5, C7). Thereby, individual sales contracts may exist linked to the fulfilment of specific requirements (C4). Aside from the VC partners involved, our case studies reveal that additional actors may flank and contribute to such solutions. These can be local governments as initiators of regional value chains (C5), research partners (C3, C4, C5), NGOs for the development and monitoring of measures (C3, C4), and sometimes also involving independent third-party control bodies (C3, C4, C8).

Often, VC solutions have a regional focus, e.g. by involving local partners (C3, C6, C10, C11) or using regional selling points (C5). Especially in regional chains, trusting and reliable relationships between partners were said to evolve more easily due to personal contacts and pre-existing relationships (C3, C5, C10). This seems even more important as the dependence of farmers on a single contractual party was also considered a threat in some cases (C3, C10). In addition, a regional focus was seen as beneficial for the regional economy. It was noted that the economic value remaining in the region strengthens the viability of rural areas (C2, C3, C5). Regional reference may also serve as an additional selling argument (C1, C3, C5, C7): AECPGs benefits (e.g. diverse landscape; higher groundwater quality) become directly visible in the region, fostering regional consumers' acceptance of the products (C5). In one case (C1), the regional link in connection with a higher product quality (referring to the public good of quality and security of products) was highlighted "*A Bulgarian product with high quality from the natural reserve can reach the Bulgarian market and consumers, whose demand for Bulgarian eco-friendly foods is rising in recent years*".

Marketing (VC4): The development of several of our sample VC solutions has been driven by consumers' increasing demand for products from sustainable and regional production (C1, C2, C4, C6, C7, C9, C10), which motivated companies to convey a better/greener image of production. As a result, most VC solutions include some sort of marketing strategy, which normally addresses final consumers: via branding activities (C1, C3, C4, C5, C6, C7, C9, C10) and thought-through communication (C1, C3, C4, C5), the environmental advantages, the origin of the products, and their potentially higher quality are highlighted (C1, C3, C4, C5, C9). The realization of premium prices is strongly dependent on marketing activities and the related building of knowledge and awareness among consumers. Nevertheless, even if strong marketing strategies are installed, some case studies reported the competition with other labels/programs as a major threat to the success of VC solutions (C8, C10).

Collective elements (VC5): While the inclusion of the private sector in AECPGs provision via VC contracts can activate private money to support producers to produce in a more AECPGs-friendly way, such solutions can entail risks for producers. The case studies reported the dependency on processors/distributors/retailers as main threats (C2, C3, C4, C6), which becomes especially critical if large retailers and processors are involved. In several of our VC case study examples, this risk was buffered, by contract solution design including a cooperative element. Such cooperation can come in the form that producers have formed a cooperative (C9), or producer organization (C1, C2, C3, C6, C10). One reason to add such elements was for farmers to combine their bargaining power (C10) aimed at receiving better prices (C9). Other forms of collective efforts are the organization of joint marketing (collective branding) (C3) or joint storage, processing, and distribution of goods (C7). Besides advantages as regards fairer power distribution, the collective element in VC contract solutions has also been perceived to spur networking and knowledge sharing among participants (C5, C7, C10).

4. Discussion

The objective of this case study-based analysis was to gain a deep insight and understanding of the design of successfully implemented contract solutions for the enhanced provision of AECPGs in agriculture and forestry. We investigated 44 real case examples of such solutions across 13 European countries, focusing on result-based, collective, and value-chain-based approaches. Our study allows, on the one hand, for a broad overview of how such contract solutions are shaped in practice, and, on the other hand, it identifies and describes important performance features.

4.1. Result-based contracts: reliable result monitoring indicators and risk alleviation through flexibility

The analysis of existing RB-schemes brought to the fore that suitable methods of how result are monitored, as well as mechanisms steering the flexibility in the management embedded in the schemes are key design features influencing implementation success.

With regard to monitoring, the RB case studies showcased a broad spectrum of approaches from direct measurement of AECPGs, to scoring or point-based systems, or the use of key performance indicators (KPIs) based on indirect or proxy metrics. It became clear that each approach involves a trade-off between accuracy, complexity, and cost: direct measurement methods are most closely aligned with AECPG goals, enabling long-term assessments of AECPG changes. However, direct measurement requires reliable and robust indicators, which are clearly linked to and influenced by land management practices (Bertke et al., 2008; Birge et al., 2017; Herzon et al., 2018; Wezel et al., 2018), measurable with reasonable effort (Matzdorf et al., 2008), and understandable to farmers (Allen et al., 2014; Kaiser et al., 2010). The literature emphasizes that besides capturing environmental effects, such indicators must also reflect the effort and agency of the participating farmers (Burton and Schwarz, 2013). Developments in technical, mobile or remote sensing-based measurement tools, e.g. allowing the identification of plant and insect species via DNA screening or photos, or the localisation of habitats or satellite images, could facilitate direct measurement approaches in the future (Zavalloni et al., 2025). In contrast, scoring and point-based systems may be less precise in ecological terms but can make farmers' contributions easily visible, thus promoting learning and acceptance. KPIs, on the other hand, are easier and less costly to implement, as they rely on secondary data and proxy indicators (Barış et al., 2025). However, their weaker linkage to farmers' actual management activities and to AECPG outcomes often prevents the observation of causal effect-chains and the sought changes in AECPG provision, and can therefore reduce legitimacy, motivational potential and the building of knowledge and social capital. Ultimately, we find that the choice of monitoring approach must find a balance between scientific rigor, administrative and economic feasibility, and farmer engagement. The diversity of successful RB schemes in our sample suggests that there is no one-size-fits-all solution and that monitoring systems must be tailored to the context-specific objectives, data availability, and the needs of the land managers and stakeholders (e.g. monitoring agencies).

In addition to reliable and robust monitoring, our analysis finds another interrelated design features contributing to the success of RB schemes, namely the flexibility in implementation. Flexibility appears to be a critical driver of farmer engagement and innovation. Many successful RB schemes in our sample grant farmers freedom in deciding on the management practices as well as their timing and exact location. Linking the payment to the environmental outcome instead of paying for the fulfilment of prescribed activities facilitates the integration of farmers' and foresters' local ecological knowledge into land management decisions, thereby enhancing the context-sensitivity and environmental effectiveness of interventions. Importantly, this also aligns with our findings on the central role of knowledge in RB schemes: while advisory support and training help farmers to understand and implement complex requirements, the flexibility of decision-making allows them to apply and adapt that knowledge in their own land. The literature confirms that such flexibility strengthens farmers' sense of ownership, increases satisfaction, and can lead to more innovative environmental practices (Chaplin et al., 2021; Mettepenningen et al., 2013; Opdenbosch et al., 2024; Ruto and Garrod, 2009).

A further key factor for the success of RB schemes is the role of farmers' knowledge. On the one hand, knowledge is the prerequisite for implementing RB contracts, on the other, it can be the outcome of participation. Our case studies revealed that most successful RB schemes are supported by targeted knowledge transfer mechanisms, such as targeted advisory services and training programs, and the provision of technical tools or materials. In many cases, nature conservation advisors are directly involved in the development and implementation of the contract solutions, supporting land managers in in the choice and implementation of suitable management practices aimed at enhancing environmental outcomes. This aligns with literature that emphasizes the enhanced importance of farmer knowledge and skills in RB schemes compared to action-based approaches (Mack et al., 2020). Moreover, literature identifies knowledge and knowledge support as essential to close technical and informational gaps in order to reduce the perceived complexity of RB contracts (Allen et al., 2014; Hagemann et al., 2025; Wezel et al., 2018) and to strengthen farmers' self-efficacy as a key driver of their willingness to engage in RB schemes (Eichhorn et al., 2024a). Several case studies also highlight that learning from experiences, peer exchange, and the link between management actions and measurable ecological outcomes contribute to the development of cultural capital. Especially the process of learning-by-doing improves environmental awareness and enhances the perceived legitimacy and meaningfulness of the schemes. Also Burton and Paragahawewa (2011) argue, that incorporating non-economic forms of capital, such as

cultural capital, is essential for the long-term viability of agri-environment-climate programs. Nonetheless, the provision of high-quality advisory services is resource-intensive, and the high costs can represent a barrier to broader implementation.

4.2. Collective implementation: Addressing landscape-level challenges

The analysis of collective contracts in our study showed, that such solutions are especially employed and effective if landscape-scale AECPG issues are addressed, such water quality improvement or habitat fragmentation and thus biodiversity. We could identify specific design features aimed at particularly enhancing e.g. shared commitment and trust amongst participants, as well as improved coordination, which strongly enhance the success of these solutions. A central finding concerns the degree of formalization within collective groups, which varies widely across our cases. On the one hand collectives exist which are formalized relatively strongly, e.g. by establishing a legal entity or managing payments at the group level. On the other hand, our cases show that also solutions without such an organizational structure can be successful. Here, group members might apply individually for funding while still committing to a common goal or shared environmental objective. Also OECD (2013) describes such variation in collectives, where the typology ranges from farmer groups fully organized, to initiatives led externally or to farmer collaborations which are only loosely coordinated (OECD, 2013; Uetake, 2013). The cases investigate by us however suggest that clarity in roles and responsibilities is improved by more comprehensive formalization tends, supporting more effective collaboration. Besides formalization, the presence of a dedicated intermediary or coordinator, who takes responsibility of organizing group meetings, who manages the communication processes and ensures compliance and knowledge exchange is another key success factor. Actually, the role of the intermediary cannot be stressed enough, as good coordination helps to distinctively promote motivation and participation, lower transaction costs for farmers, and build trust among the whole group and its members. This finding also substantiates existing research emphasizing the importance of trusted facilitators who are able to trustfully connect local actors and government agencies, especially in complex landscape-scale interventions (Emery and Franks, 2012; Franks, 2011; Franks and Mc Gloin, 2007; Grahl et al., 2026; Tyllianakis, 2024). Normally, multi-faceted environmental outcomes addressed in collective solutions go along with a high level of complexity. Here our analysis showed that successful cases often lay down operational guidelines as well as clear definitions of AECPG goals in conservation plans or common management agreements. Also literature suggests that solutions based on collective incentives should best be formally organized and employ a so-called "statute", which defines the organisational structure, criteria of participation, etc. (Franks, 2011). Such formal statutes and guidelines are particularly important to organise coherent spatial coordination, which is an essential factor of success of optimal AECPG provision on a landscape-level. A last success factor to be discussed in the frame of collective solutions is social cohesion. Our results showed that collectives characterized by homogeneity, e.g. in farm size, practices, goals, and geographic proximity, enabled easier cooperation and common understanding. Design features enabling regular meetings and the exchange of views can reinforce such social bonds and therefore enhance both collective commitment and efficacy. This finding substantiates existing studies which stress that social factors are even more critical in collective solutions than in individual payment schemes (Hayes et al., 2019; Reed et al., 2014) and that regular internal meetings can foster social learning (Barghusen et al., 2022; Grahl et al., 2026).

4.3. Value chain-based contracts: market integration and consumer awareness

Our analysis revealed some key characteristics for the success of value chain-based contract solutions. In our cases, AECPG improvements were always clearly linked to the production of specific private agricultural goods with a defined and sensitive consumer market, such as rice, olives or meat. AECPG benefits were reached by complying to predefined and prescribed environmental production standards within the production process. While also literature states that value chain contracts typically address AECPGs as attributes of agricultural commodities (Boyd and Wainger, 2003), our cases showed that these contracts are mostly only in place for products where the connection between AECPGs and production processes is clear to consumers. Also, and this is critical, it became obvious that mainly such AECPGs are addressed, which might be valued by consumers, such as specific biodiversity or animal welfare, while more complex, unknown, or "hard to sell" AECPGs, are rarely addressed by value chain solutions. Our results further reveal that the form of economic advantage provided to farmers by the solution is key for success or failure. Our cases thereby showed that access to markets, increased profitability due to fair payment mechanisms, and premium prices can drive land managers' acceptance of such solutions. This result is also supported by literature, describing economic incentives such as price premiums, environmental labels and sales guarantees as strong motivators for producers to adopt environmentally friendly practices (Daugbjerg et al., 2014). Literature further states that the design of value chain contracts is particularly challenged by the necessary coordination between a large range of diverse actors, involving advisory service providers, processors, retailers, and, last not least, farmers (Riccaboni et al., 2021). Here, our analysis reveals that existing relationships as the foundation of such contracts, as well as a focus on short, regional value chains can build trust among the actors involved, reduce transaction costs and finally facilitate implementation. This is also in line with literature such as Chobotová (2013), highlighting that the success of market-based instruments for biodiversity conservation is strongly influenced by its formal and informal institutional setting. Also, effective communication, trust, equity, fairness and reputation, are acknowledged as essential for the acceptance of such contracts (Chobotová, 2013; Krause et al., 2021). In general, we also found that "being market-based" is in itself a success factor of this type of contracts, enhanced by strong branding and effective marketing strategies. Lately, major value chain actors, including retailers and food companies, have been prompted by consumers' increased demand and willingness to pay for environmentally friendly products to include the provision of environmental benefits into their companies' marketing strategies, providing both producer contracts and financial support (Chobotová, 2013; Kempa, 2013; Li and Kallas, 2021). However, in order to avoid greenwashing when establishing food-labeling schemes it is inevitable to ensure that environmental outcomes are reached (De Schutter, 2017). Thereby, not only certification is required, but also sound monitoring frameworks, compliance, and robust production standards (Schulze et al., 2024), involving scientific support in the development of measures and monitoring, external governance and the engagement of diverse actors such, public bodies associations, or NGOs (Boström and Klintman, 2008; Le Coq et al., 2011).

4.4. Additional benefits through hybrid solutions

The analysis of our case studies revealed that nearly half of the successful contract solutions combine elements of different contract types. It could be seen that such hybridity brings additional benefits: Many RB schemes within our case studies combine result-based payments with elements from other contract types, e.g. action- and market-based mechanisms. This combination can address several limitations which can occur in pure RB approaches, i.e. farmers' risk of goal achievement (Chaplin et al., 2021; Eichhorn et al., 2024b), high advisory costs, and dependence on public funding. In some examples RB payments have been combined with action-based funding, rewarding specific practices as a minimum baseline or providing resources for specific conservation measures. Here the result-based component is

"on-top" and therefore reducing the perceived risk to farmers while maintaining the result-based element. As discussed earlier, effective monitoring systems must provide a balance between accuracy and feasibility. Here, hybrid contracts can provide a greater flexibility by combining strict result measurements with more easily implemented actions. In this way, other success factors such as farmers' learning, the operationalization of indicators, and administrative efficiency can be reinforced. A study by Gars et al. (2024) investigates farmers' preferences among practice-based, result-based, and hybrid agri-environmental schemes across three countries using a choice experiment. It finds that farmers generally favour practice-based schemes for water quality and climate change mitigation over hybrid or result-based options. The study also reveals that only a few hybrid schemes are both preferred by farmers and offer greater social benefits than comparable practice- or result-based schemes. Besides the hybrid of RB and action-based, several RB cases integrate market-based instruments, such as carbon credit trading, thereby opening pathways to private financing. This, on the one hand, diversifies funding sources and reduces the dependency on limited public funds, and on the other, connects the RB contracts to broader environmental markets, which might increase their future relevance and scalability. As Bredemeier et al. (2022) suggest, hybrid models offer a more adaptable framework for tailoring RB schemes to institutional conditions.

An additional rather common combination occurs in VC contracts, while VC contracts might serve as a solution to foster AECPGs provision without full or partial dependence from public funding (Kroeger and Casey, 2007), particularly for farmers they might carry risks of dependency and power imbalances (De Schutter, 2017). Decision-making rights, for example, are often more on the side of the companies than on smallholder farmers, and a study by Manyise and Dentoni (2021) showed that wider distribution of decision-making rights can improve value-chain contracts. Here, collective action, e.g. in the form of farmer cooperation within the contracts, might serve as risk mitigating mechanisms which can strengthen the producers position, increase their bargaining power against other actors within the value chain, secure better prices and ensure equitable outcomes (De Schutter, 2017; Trebbin, 2014).

4.5. Discussion of the research approach and limitations

With regard to the research approach in this study, some limitations need to be acknowledged. First, due to the case study research strategy used in this study, the generalisability of the findings is limited, representing a general criticism towards case studies (Yin, 2003). However, our case studies have been selected following clear selection criteria defined upfront and represent a high diversity and number of cases. With this approach, our results are supported by not only individual single-standing examples but by a considerable number of cases. Second, the case studies varied in their duration, ranging from initiatives that had just begun to those that had been ongoing for several decades. The success of "young" cases, particularly regarding their long-term success, is not guaranteed. Third, it is clear that the amounts of funding provided by heterogeneous funding sources, as evident in our cases, strongly drive the success beyond the design features themselves. Fourth, the study covers contract solutions on forest land as well as on agricultural land while acknowledging that they very much differ inter alia regarding the time it takes to achieve environmental improvements, which is often mirrored in the contract length and the AECPGs addressed. Fifth, we limited our analysis to the AECPGs adapted by Cooper et al. (2009), although our case study analysis might have identified additional public goods. We chose this focused approach because data collection was based on a pre-structured protocol with adapted wording and a free-text option to capture specificity while ensuring comparability and consistent terminology across our case studies. Furthermore, they were consistent with the project-wide use of AECPGs (Cooper et al., 2019) and enabled practice-oriented, searchable case studies in the form of fact sheets.

5. Policy recommendations and outlook

The analysis of result-based schemes, collective implementation, and value chain-based contracts underscores the need for flexible and targeted policy interventions to foster the provision of agri-environmental and climate public goods effectively. Therefore, it is necessary to complement the current path dependency dominated by action-based payments, particularly regarding publicly funded schemes under the Common Agriculture Policy (CAP). The currently discussed proposal for the CAP 2028–2034 (COM(2025) 560 final), foreseeing a shift from prescriptive conditions to rewarding positive actions, provides opportunities in this direction. Member states are expected to have even greater flexibility in the design of CAP interventions to better take into account local conditions and needs, providing a window of opportunity to program result-based and collective schemes. On the other hand, the high degree of subsidiarity foreseen in the future CAP will significantly increase the responsibilities of the member states. At the same time, given the need for greater private sector involvement, more emphasis is being placed on private engagement in environmental sustainability in the agricultural sector. Contracts covering value chains therefore deserve greater attention. In the Communication "A Vision for Agriculture and Food" (COM(2025) 75 final) it is stated that, the "food and drink industry, as well as the retail sector, have also a crucial role to play in contributing to the 2040 climate target and the environment protection." This is supported by recent developments in EU environmental legislation, including the Corporate Sustainability Reporting Directive (Directive (EU) 2022/2464), the Carbon Removal Certification Framework (CRCF; Regulation (EU) 2024/3012), and the Nature Restoration Law (Regulation (EU) 2024/1991) alongside with initiatives like the "Roadmap towards Nature Credits" (COM/2025/374 final).

For increasing land managers' engagement and success in result-based schemes, it is critical to enhance their self-efficacy and skills. We therefore suggest that the support of capacity building and knowledge exchange, in terms of the funding of training programs and advisory services should be prioritised by policy, including in the next CAP. As regards the development of monitoring mechanisms in RB schemes, both reliability and user-friendliness must be guaranteed. Suitable indicators must enable a balance between administrative simplicity and monitoring rigor in order to guarantee that monitoring is both practical and cost effective for land-managers and authorities, but still scientifically robust. Contract design should stive for land managers flexibility as a key driver of acceptance, allowing them to adapt their land management to individual preferences and local conditions, and thereby enhancing satisfaction, innovation and ownership. Hybrid contracts should be promoted, suited to broaden the appeal of the schemes and to distribute risks, e.g by the combination of RB payments with market mechanisms of action-based funding.

To foster collective implementation of environmental measures, the establishment of formalized collective structures should be supported by policies, setting clear governance frameworks suited to coordinate effective environmental management on a landscape-scale. Resources should be allocated to support and empower coordinators or intermediaries who play a key role in reducing transaction costs, facilitating communication, and building trust among participants. Furthermore, investment in social capital development, through initiatives that promote trust-building, knowledge exchange, and joint learning, is essential for sustaining collective action over time.

Regarding value chain-based contracts, existing market structures should be leveraged by policies, encouraging the integration of environmental objectives especially within established regional and short supply chains. Transparent and credible eco-labeling systems, supported by rigorous monitoring and certification, must be developed and to safeguard against greenwashing and build consumer trust. Strengthening producer organizations is equally critical to enhance farmers'

bargaining power and balance the asymmetries within value chains. In parallel, policies should support consumer awareness campaigns that raise demand for environmentally friendly products, thereby reinforcing market incentives for producers to adopt sustainable practices.

Across all contract types, diversification of funding sources emerges as a central recommendation. Although it is clear that public funding is still the major mechanism to overcome market failure in the provision of AECPGs, policymakers could facilitate blending public funding with private investments and market-driven incentives. Adaptive and context-specific policy frameworks that recognize the diversity of local conditions, farmer characteristics, and landscape complexities will be essential for engaging governments, non-governmental organizations, market actors, and farmer groups, is necessary to co-design and co-manage agri-environmental solutions that are both socially acceptable and environmentally effective. Investments in data infrastructure and advanced monitoring technologies will further enhance transparency, evaluation capacity, and continuous improvement of such novel contract mechanisms.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.landusepol.2026.108196.

Data availability

Data used for this research article is published under: https://doi.org/10.5281/zenodo.7248041.

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