EFFECT

CONTRACTS FOR AGRI-ENVIRONMENTAL SYSTEMS

GUIDING DESIGN CHOICES IN THE AGRI-ENVIRONMENTAL SCHEMES: LESSONS LEARNED FROM NINE CASE STUDIES IN EUROPE

BEST PRACTICE E-BOOK

Summary

1.

Design and implementation of Agri-Environmental Schemes

Agri-environmental schemes (AES) are initiatives put in place to encourage farmers, through economic incentives, to adopt practices that contribute to environmental and climate goals.

AES spur farmers to meet society's demand for more environmental benefits/reduction of environmental damage from farms and their management. These initiatives have been gradually incorporated into the European Union's Common Agricultural Policy (CAP).
Also, AES encourage farmers to implement environmentally friendly practices that would otherwise be abandoned, or to modify existing methods in ways that will reduce environmental impacts.

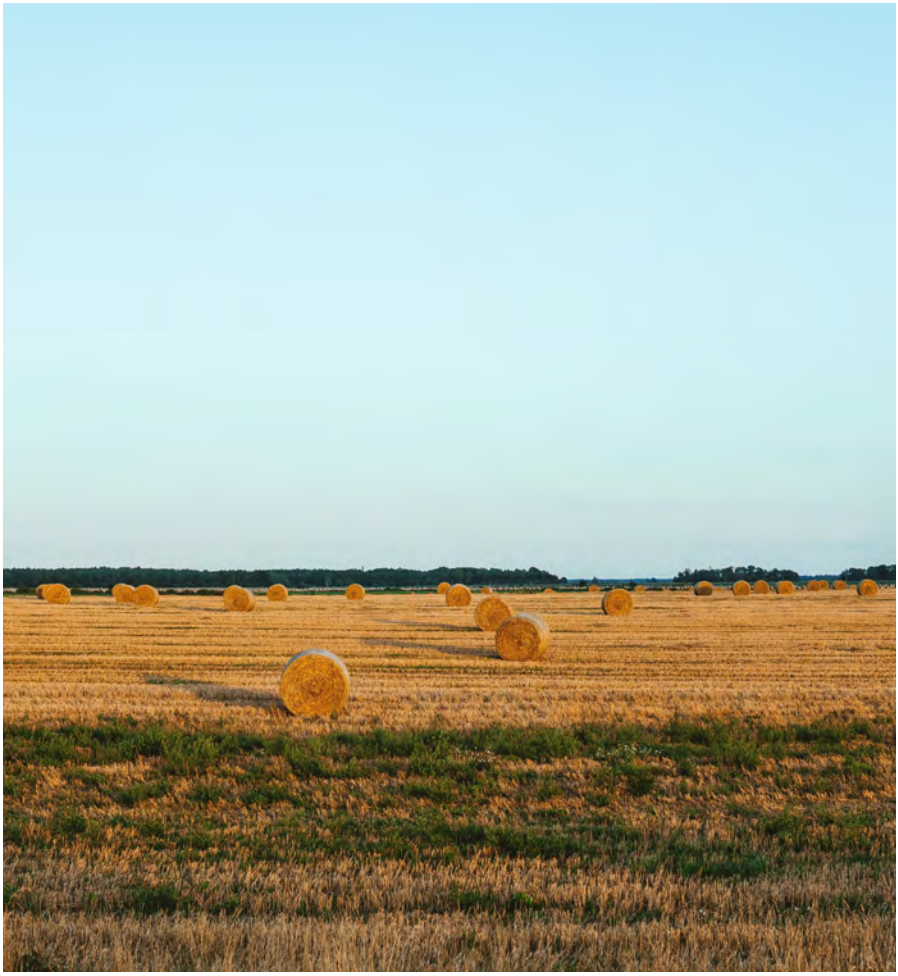
From an economic point of view, they are voluntary agreements between private landowners and (typically public) buyers of ecosystem services, often facilitated by public agencies or NGOs acting as intermediaries. They thus fall under the broader category of Payments for Environmental Services (PES), employing conditional incentives: buyers only pay to the extent that contractual stipulations about environmental service provision have been fulfilled.

The voluntary nature of AES necessitates a good understanding among stakeholders of the particular scheme in order to enhance farmers' willingness to adopt the practices and accept the compensation. Farmers with intensive, highly capitalised land-use operations tend to have greater opportunity costs and tend to participate less in AES, than those with low-input operations.

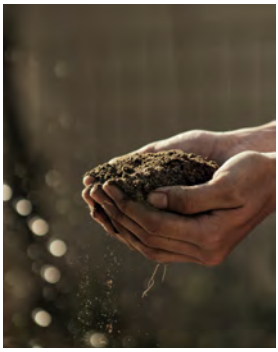
The EFFECT project has conducted reviews of the literature on the performance of AES and on the factors determining their environmental effectiveness, economic efficiency and acceptability to farmers. Furthermore, thorough in-depth analysis and experimentation in nine European cases, EFFECT has sought to derive lessons learned and analysed their transferability to other policy contexts.
This e-book analysis synthesises the lessons learned through a Theory of Change (ToC) for AES. This highlights the issues at stake and the strengths and weaknesses of alternative design options.
The document concludes by providing guidance to policy on best practice in AES design and highlights the potential of novel design options.

2.

Theory of change for AES



This synthesis first employs a Theory of Change (ToC) – a framework which identifies ordered sequences of staged effects on how a system responds to interventions towards a desired final impact. Our ToC analyses the causal chains to assess the requirements for AES effectiveness, drawing insights from our cases, with particular attention to three results:



Farmers Participation

Environmental Additionality

Cost Effectiveness

The theory of change thus offers a structured understanding of how an intervention works step by step to achieve meaningful impacts. It untangles complex socio-environmental systems and considers both short- and long-term effects across environmental, economic and social domains.

This offers a structured framework to assess and compare the effectiveness of AES across different contexts. Typically, this includes the definition of criteria and objectives, the selection of relevant case studies, data collection, monitoring, evaluation and comparison between actions, and resulting recommendations. In EFFECT, we defined lessons learnt vis-à-vis focus areas for the different stages in the AES theory of change:

INPUTS

Institutional needs:

- Legal-administrative framework
- AES intermediaries
- Financing resources

Contextual knowledge:

- Baseline vs alternative scenarios, threats & opportunities (farming intensification and abandonment)
- Current ES flow and biodiversity stock
- Opportunity costs and added ES values

TREATMENTS

Conditional incentive design

- Contract lenght and terms
- Action vs result based
- individual vs collective contracts
- Preservation vs modification of practices
- Flexibility
- Bottom-up vs top-down design

Complements

- Inclusive design
- Technical assistance
- Environmental awareness
- Knowledge exchange

OUTPUTS

- Farmers participate at adequate scale
- Farmers understand/accept treatment(s)
- Farmers change attitudes

OUTCOMES

- AES recipients adopt desiderable agricultural practices/actions
- AES measures are implemented in locations where they are most effective
- Farm incomes well-supported

IMPACTS

- ES benefits enhanced vis-à-vis baseline (targets reached)
- Farmers' income sustained
- Rural development achieved

An AES Theory of Change (ToC). ToC stages of the design, implementation, and impact of AES. Source: Wunder et al. (2023) (Deliverable D6.11)

Analysing the performance of agri-environmental policies is a multi-dimensional task. More than one performance criterion should be used, and comparisons need to be made along several dimensions.
It is good practice to include the following criteria: effectiveness, cost-effectiveness, dynamic efficiency, transaction costs, and fairness.

1. ENVIRONMENTAL EFFECTIVENESS

Addresses the question to what extent a policy is achieving the stated objectives. It is closely related to farmer participation in an AES and the suitability of the land-use prescriptions in achieving the scheme's objectives.

2. COST-EFFECTIVENESS

Is measured as the cost per unit of environmental service provided; it measures the value-for-money a government agency achieves with taxpayers' money. An alternative interpretation of cost-effectiveness relates to the forgone profits, or opportunity cost of service provision, which measures the cost to society of providing environmental services.

3. DYNAMIC EFFICIENCY

Is concerned with the question of whether a policy provides its addressees with a continuing incentive to innovate and enhance their environmental performance of their own accord.

4. TRANSACTION COSTS

Are the costs of facilitating an economic exchange, in the case of AES, between farmers and a public agency. High transaction costs on the part of farmers can act as a deterrent to participation and cost effectiveness. Poor administrability can lead to high transaction costs for the public agency.

5. FAIRNESS

Finally, fairness relates to the distributional impacts of a policy: who benefits and who bears the costs? Policies that put a disproportionately high burden on disadvantaged groups in society (e.g., low-income farmers) are called regressive and should be avoided.

3.

EFFECT case studies

European agricultural landscapes exhibit significant diversity, ranging from countries like Hungary and Denmark where cultivated land dominates, to Finland and Sweden, characterised by extensive forests and wilderness. Agrochemical inputs are prevalent in more than 60% of farmlands, with livestock concentration being higher in central and northern Europe than in the east and south. Historically, agri-environmental policies have differed: northern Europe prioritised nitrate pollution regulations, the UK emphasised nature conservation, and southern Europe mainly aimed to boost agricultural productivity.

Across Europe, farming falls along a wide spectrum of intensity, determined by input use per unit of land. Extensive farming, practiced in less productive regions, utilises fewer external inputs but often faces abandonment due to lower profitability. Certain extensive farmlands support diverse biodiversity, exemplified by High Natural Value (HNV) farming, which underscores the positive influence of traditional extensive methods on biodiversity. Conversely, intensive agriculture on fertile land has led to environmental problems like water pollution and biodiversity decline. AES aim to both maintain threatened extensive practices and to adjust intensive ones towards environmentally more sustainable outcomes.

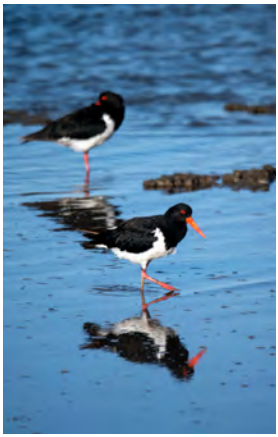
The EFFECT project encompasses nine AES cases across Europe, targeting diverse agri-environmental benefits to suit this heterogeneous landscape.

Further information:

- *European agri-environmental policy: Evolution, effectiveness, and challenge*
- *Implementation of Eco-Schemes in Fifteen European Union member States*

BIRD BIODIVERSITY CASES

Biodiversity offsetting



Oystercatchers looking for preys
Credit: David Clode Unsplash

Where:
United Kingdom

Action:
This case study focuses on landscapes providing habitats for wading bird species like curlews, lapwings, and oystercatchers: these are particularly present in moorlands, low-intensity grasslands and coastal zones. These habitats face potential disruption due to housing, river, and port developments, as well as land use changes linked to farming. The case introduces a hypothetical biodiversity offset model aligned with the Environment Act 2021, aiming to counterbalance the impact of new development projects by creating new biodiversity-rich zones that offset negative human impacts.

Collective contracts between agrarian cooperatives and farmer members

Flower borders in an agricultural landscape in the Netherlands
Credit: Wur.nl

Where:
The Netherlands

Action:
The AES has been active since 2016 in farmer collectives like Noardlike Fryske Wâlden, which act as intermediaries between farmers and the provincial government to support meadow bird conservation efforts. Farmers can select from a range of agricultural approaches and farming methods, and the collectives coordinate across farmers to create an optimal environment for meadow bird conservation.

Cooperative results-based bird conservation contracts

Curlew
Credit: Bob Brewer Unsplash

Where:
Schleswig-Holstein, Germany

Action:
Implemented since 1997, this local programme aims to safeguard ground-nesting meadow birds in lowland pastures. Agreements between farmers and the nature conservation agency are verbal, but nevertheless binding to limit farming in designated bird-breeding zones. Compensation is determined by the number of bird clutches per hectare (outcome-linked) and the delays in farming operations (activity-based).

WATER RESOURCE CASES

Collective contracts for spatial coordination of water quality enhancement

Nordsminde catchment
Credit: SEGES Innovation

Where:
Denmark

Action:
Since 2017, a spatially targeted AES has been providing compensation to individual farmers using funds from both national and EU-Rural Development Programme sources. This scheme supports implementation of catch crops, which are effective in capturing surplus nitrogen in soils susceptible to leaching. Farmers have flexibility to select alternative measures to mitigate nitrogen levels. Although engagement in this initiative is optional, in cases where landscape-scale objectives for curbing nitrogen levels in downstream water sources are not achieved, all farmers that have not participated will have to introduce compulsory catch crops at their own expense (regulatory threat).

Investments contracts for climate adaptation and water quality enhancement

Drought areas in Hungary calculated with Pálfai drought index
Credit: AKI – Kemény G, Lámfalusi I, Molnár A (2018)

Where:
Hungary

Action:
The AES in Hungary promotes both individual and group investments in upgrading irrigation systems to lower water and energy consumption in agricultural areas. The programme's objective is to involve farmers in creating plots of land that function as natural filters, thereby decreasing the impact of excess nutrients on watercourses.

Contracts to improve uptake of nutrient management technologies

Black Tailed Godwit
Photo credit:
Vicent Van Zalinge

Where:
Catalonia, Spain

Action:
The approach taken here through the Rural Development Programme (RDP) 2014-20 helps local farmers in enhancing their fertilization practices by improving their efficiency. It provides financial recompense to farmers for the supplementary expenses incurred in analysing soil and manure, and renting innovative machinery for a more accurate application of manure and mineral fertilizers.

GRASSLAND BIODIVERSITY CASES

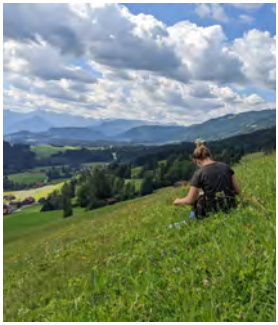
Results-based management of hay meadows

Breite Oak Tree Reserve, a 74-hectare nature reserve sitting on a plateau atop Sighișoara, Romania

Where:
Romania

Action:
This RDP-associated pilot programme, implemented from 2014 to 2020, incentivized farmers in the dry grasslands of Transylvania to embrace farming methods that preserve the existing local plant diversity. Farmers could select one of three different packages based on 5, 8 or 10 flowering species from a list of 30 species tested as indicators of high nature value grassland in the pilot scheme regions. Different parcels owned by the same farmer could have different payment rates, according to the number of flowering species recorded.

Results-based contracting for biodiversity conservation



Collecting farm-level biodiversity data as part of Credit: Carolin Canessa

Where:
Bavaria, Germany

Action:
This RDP associated case ran from 2015 to 2022, advancing the practices of comprehensive grassland oversight. Dairy farmers can select among particular actions (such as postponing mowing, controlling livestock numbers, preserving delicate zones, and maintaining untrimmed grassland strips), with the objective of improving on a baseline level of four distinct species that indicate biodiversity.

Contracts to provide flower fields for pollinators

Low-diversity mixture grown for the honeybees in rural area in Estonia

Where:
Estonia

Action:
Launched through the country's national RDP in 2015, this action involves farmers in establishing strips of flowers aimed at aiding honeybees and their pollination services, while simultaneously introducing variety into intercropping. Farmers are asked to plant a minimum of three flower crops in proximity to honeybee hives, necessitating a cooperative effort between farmers and beekeepers.

4.

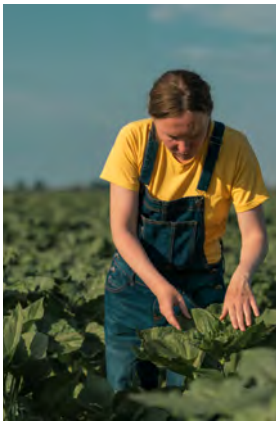
Lessons learned

The lessons learned from reviews of the AES literature and the case studies within the EFFECT project can be summarized in the following 11 points:

1. INCLUSIVENESS, INFORMATION EXCHANGE AND FLEXIBLITY ARE KEY DRIVERS OF SUCCESFUL PROGRAMME DEVELOPMENT & IMPLEMENTATION

A key insight that emerged from the research is that institutional conditions make a difference for the extent to which implementation succeeds. Institutions are enduring formal and informal rules, norms and procedures. These shape the governance arrangement within which policies are designed and implemented. They constrain certain actions while facilitating others. Hence, by intervening in the institutional design of agri-environmental governance arrangements, desired actions and interactions supporting the implementation of the scheme can be facilitated, while those hindering successful implementation can be avoided or limited. Our findings suggest that there is unutilised potential for designing more effective AES by taking a broader governance approach to AES design. In addition to designing the specific measures of a scheme, policymakers should also design the institutional setting in a way that facilitates farmer participation and engagement.

A comparative analysis of six AES in the EFFECT project showed that the implementation of agri-environmental schemes is successful in boosting farmer participation when the institutional design simultaneously facilitates knowledge exchange, flexibility in implementation, and (farmer) inclusion in the design process.
On the contrary, if none of these three institutional conditions are met, participation and capacities remain low, and the opportunities for successful policy implementation thus slim.
Intermediate degrees of implementation success occur when only one or two of the institutional conditions are present.



While this finding may appear unsurprising, it is noteworthy that the combination of fully favourable institutional conditions only occurred in two of the cases. This suggests that there are still opportunities for improving the institutional design of AES. Our suggestion is for policy designers to work through the lenses of a broader governance perspective. It is beyond doubt that the usual economic incentives motivate farmers to participate in the voluntary AES, but our research showed that to achieve implementation success, it is also important to engage farmers in the design process to create a sense of ownership of the schemes. It is equally important to facilitate information exchange that enables farmers to make informed decisions in terms of enrolment under the scheme and crucially to obtain knowledge on how to change their farming practices to achieve the desired environmental outcomes in ways which also make sense at farm level.
Finally, considering that a range of specific conditions vary across individual farms, it is critical that there is flexibility in relation to how the specific agri-environmental measures are implemented.
When this combination of institutional conditions is created by policy designers, farmers would feel more committed to deliver the desired ecosystem services.

Further information:

- *Identifying institutional configurations for policy outcomes: A comparison of ecosystem services delivery*
- *Designing successful agri-environmental schemes: A mechanistic analysis of a collective scheme for eco-system services in the Netherlands*

2. CONTRACT FLEXIBILITY INCREASES FARMERS' AES ADOPTION, BUT POTENTIAL TRADE-OFFS WITH ENVIRONMENTAL IMPACT EXIST

The EFFECT analyses show that employing flexible agreements that accommodate the diverse needs and preferences of stakeholders (e.g., choosing among recommended management prescriptions), ultimately enhanced environmental conservation efforts in agriculture.
This is because flexibility allows schemes to evolve over time, incorporating lessons learned and emerging best practices.
This adaptability ensures that agri-environmental programmes remain relevant in achieving their long-term conservation goals.
It increases the likelihood of achieving positive environmental outcomes while maintaining the support and cooperation of the agricultural community. The downside of a flexible contract design can be that overly pre-aligned farmers may not need to adapt their status quo practices, and as a result the impact of the AES "to make a positive difference" may be limited.

EFFECT observed several examples of how contract flexibility was a key concern in AES design. In Bavaria and Romania, farmers benefited from flexible contract options that empowered them to select their own management practices, and, respectively, to manage according to their customs, and thus effectively adapting to the specific socio-ecological conditions of their regions. Similarly, the Dutch initiative employed an action-based approach that afforded farmers the freedom to make choices from a diverse range of management recommendations. In the Schleswig-Holstein case, the management requirements were flexibly adapted to the needs of meadow-nesting birds on the respective parcel. This has been done in consultation between individual farmers and the respective conservation volunteers in charge, who acted as area managers. At the end of the breeding season, when the birds had left the field, farmers were free to use their land without constraints. This flexibility had contributed significantly to the farmers' willingness to participate.

In contrast, in Catalonia the chosen agri-environmental measure exhibited a more rigid design approach that conditioned farmer's uptake to the first year of implementation. Hungary and Estonia encountered challenges stemming from the complexity and lack of flexibility in their contractual arrangements, which appeared to hinder participation. While the Danish scheme has gradually incorporated greater flexibility in the selection of nitrogen mitigation measures, it continues to grapple with intricate compliance regulations.

3. RESULT-BASED SCHEMES CAN INCREASE SCHEME ADOPTION AND INCENTIVISE FARMERS TO SEEK INNOVATIVE OPTIONS TO PRODUCE DESIRED OUTCOMES BUT COME WITH A RISK OF DEVELOPING SCHEMES WITH LOW ENVIRONMENTAL ADDITIONALITY

The choice between result-based and action-based approaches can affect both participation and the environmental outcome. All three EFFECT schemes focusing on water quality adopted action-based strategies, probably due to challenges linked to monitoring and regulating non-point sources. Monitoring downstream water or groundwater quality impacts is costly and the basis for attributable payments remains uncertain. One way around this issue is to design contracts based on model-derived results using an integrated environmental-economic model and involving farmers in scheme evaluation (see item 7). The degree to which farmers accept such contracts remains the subject of future research. Cases addressing bird or grassland diversity have elicited farmer preferences through either choice experiments (BAV, NL) or focus group discussions (RO). In Bavaria, several contract features, involving hybrid schemes, were tested. Generally, farmers leaned towards result-based AES when they seemed achievable and aligned with their production system, but this sometimes led to attracting pre-compliant farmers and thus actual environmental benefits can be low. Such windfall effects are also known from action-based schemes.

The findings from Bavaria comparing real schemes points towards a higher environmental effectiveness of result-based schemes. In the Netherlands, farmers preferred fixed per-hectare action-based payments for bird biodiversity due to unpredictable external risks. Meanwhile, in Schleswig-Holstein, a hybrid scheme combining results and actions succeeded. Payments are linked to the number of bird clutches found on a farmer's parcels. However, if clutches are lost through causes beyond the farmer's control (e.g. predation or flooding), an action-based payment still remunerates the farmer for the conservation effort. While the result-based payment provides a strong incentive for farmers to maximise the birds' breeding success, the action-based component acts as a risk mitigation mechanism, which has turned out to be crucial for farmers' willingness to participate. Romania implemented both action- and result-based schemes on High Nature Value farmland; while farmers acknowledged the potential of result-based payments, they noted that they required great effort and costs to achieve the results. Furthermore, findings from the Romanian case indicate that the control system for result-based schemes is more reliable/defendable on audit missions and less time-consuming. In the UK, comparing action- and model-based result contracts revealed that model-based results payments can deliver increased species abundance for target and non-target bird species in landscapes where the ecological potential of land parcels positively correlated with the most profitable land parcels.

We underscore here the idea that the choice between result-based and action-based approaches (or the fine-tuned mix between them) depends on the features of the specific environmental system being addressed. Result-based schemes may be more suitable if environmental goals are

easy to measure, attributable to farm management and achievable in a collective framework. In contrast, action-based approaches may be preferable when competitive dynamics among farmers are prevalent, as they provide a clear and immediate incentive for individual farmers to take specific actions. In some cases, however, hybrid schemes can overcome shortages of action- and result-based approaches, respectively.

Further information:

- *Incentives, Rewards or Both in Payments for Ecosystem Services: Drawing a Link Between Farmers' Preferences and Biodiversity Levels*
- *Making bird numbers count: Would Dutch farmers accept a result-based meadow bird conservation scheme?*

4. COLLECTIVE CONTRACTS MAY ENHANCE ENVIRONMENTAL IMPACT, BUT RELY ON SOCIAL CAPITAL & LOCAL INSTITUTIONS

There is a growing understanding that collective schemes or mixed schemes, which include both individual and collective contract features, may in some contexts be effective in achieving agri-environmental targets. Potential benefits of these schemes over individual contracts include spatial coordination, ease of monitoring and lowering administrative costs. There is only one example of an operating collective agri-environmental contract in Europe, in the Netherlands, and little is known about the impact of collective or hybrid contracts on farmers' participation and environmental performance.

The already existing social norms supporting cooperation in this case could be an explanatory factor for the institutionalisation of collective agri-environmental contracts, in contrast with other country cases where farmers show preferences for individual contracts (e.g. Germany). The state-supported Dutch collective scheme improves farmers' participation and environmental effectiveness while transaction cost increased for collectives but decreased for the government actors (see Lesson 9).

Hybrid contract types can be more suitable when the purpose is to enhance spatial coordination recognising both individual-collective efforts. EFFECT investigated the performance of both collective and hybrid contracts in the Netherlands, Denmark, Germany and Hungary, addressing different environmental objectives (biodiversity, water use and water quality).

The incentive structure of these collective contracts ranges from individual contracts with additional payments based on group performance to a purely collective contract where outcomes are determined solely by group performance. The evaluation in EFFECT has been based on experiments, except for the Dutch case, as collective AES contracts have not yet been widely implemented. In an experimental investigation in Denmark, we demonstrated that a pure collective agri-environmental program, where rewards or sanctions are based on collective rather than individual performance, has the potential to enhance environmental effectiveness, social efficiency and equity.

In hybrid contracts, in the German case (Schleswig-Holstein), where contracts involve both individual and collective components, we demonstrated that an agglomeration bonus can enhance spatial coordination in conservation activities. Similarly, in Hungary, an individual water use (irrigation) scheme, which was supplemented with a contingency bonus, increases farmers' likelihood of enrolling into the contract.

Contracts with a collective element can take designed in many different ways. The real-world empirical evidence for the effectiveness of different design options is limited. It is therefore to early to say which design is more effective in different socio-ecological contexts. This remains a question for further research.

Further information:

• Mapping biodiversity and cultural values complemented with understanding of social dynamics provides effective means for addressing opportunities for nature conservation in a cultural landscape.

5. COLLECTIVE BONUS PAYMENTS CAN MOTIVATE FARMER PARTICIPATION AND SPATIAL COORDINATION, BUT THEY CAN REDUCE COST-EFFECTIVENESS

Collective bonus payments aim to encourage collective action (such as spatial coordination of conservation efforts) among farmers in the provision of environmental goods and services. The most prominent example is the Agglomeration Bonus (AB) for spatial coordination. The AB is an additional payment made when neighbouring farmers jointly contribute adjacent land to an AES. Although the AB has been advocated by the scientific community, there is so far only one application in Europe: the Swiss Network Bonus.
Other bonuses to encourage participation and spatial coordination are the Threshold Bonus (TB) and the Threshold Payment (TP). The TB is paid to landholders (in groups or as individuals) on top of a standard

payment if a certain level of participation or spatial connectivity at group (landscape) level is reached. Rather than a bonus payment, the TP is designed as an all-or-nothing payment.
The payment is made only if a certain level of participation and/or spatial connectivity at the landscape level is reached. Landholders are thus at risk of receiving nothing if such a predefined threshold is not met.

The effectiveness of the different spatial coordination incentives has been the subject of many theoretical and experimental studies.
The theoretical studies consistently emphasise the high potential of spatial coordination incentives in enhancing participation, spatial coordination, and environmental effectiveness. By contrast, the results derived from experimental studies in the literature are mixed for the Agglomeration Bonus and Threshold Payments. Generalising the positive outcomes of these innovative incentive mechanisms should therefore be considered with caution.
The cost-effectiveness of spatial coordination incentives has been a subject of debate in both the theoretical and experimental literature, with some studies indicating enhanced cost-effectiveness, others suggesting reduced cost-effectiveness, and still others finding no effect at all. Cost-effectiveness has not been evaluated for the few real-world schemes that apply collective bonus payments

Finally, experimental results from EFFECT show that the Agglomeration Bonus is likely to be effective in promoting spatial coordination only in landscapes where high environmental benefits coincide with high opportunity costs of putting land under conservation management.
It could be counterproductive in landscapes where parcels with high environmental potential have low opportunity costs. It reduces cost-effectiveness in all the cases studied.

Given the scant literature and our research findings, we feel that it is too early to make any general recommendations on the choice of which particular type of collective bonus will work best in any specific real-world setting.

Further information:

- *Spatial Coordination Incentives for landscape-scale environmental management: A systematic review.*

6. SPATIAL TARGETING IMPROVES ENVIRONMENTAL BENEFITS AND COST-EFFECTIVENESS, BUT INCREASES ADMINISTRATIVE BURDEN

It is important to underline the potential of spatial targeting in AES to enhance environmental benefits and cost-effectiveness. Spatial targeting involves pre-selecting specific geographical areas or criteria for AES eligibility. It allows for the efficient allocation of resources, as it focuses on areas with the greatest environmental needs or potential benefits and enables the customisation of conservation practices. However, spatial targeting can be more administratively complex, requiring detailed geospatial data, monitoring, and coordination. In addition, spatial targeting may result in the exclusion of some farmers or regions from agri-environment schemes if their areas are not considered high-priority. This could lead to inequality in access to monetary benefits.

In the EFFECT cases, some spatial targeting has been used to maintain specific conservation areas and restore degraded landscapes. For example, in Romania, spatial targeting focused on AES enrolment on High Nature Value farmland designated by national authorities. Evaluating policy options in the Danish case, a comprehensive spatial targeting

approach was tested, proving to be highly cost-effective due to the considerable spatial variations in mitigation potential, environmental effectiveness, and associated costs. In contrast, farmers in Estonia were required to cultivate at least three melliferous plant species within 200 meters of beehives which limited eligibility to field clusters located next to beehives. This measure thus customised spatial targeting to the desired ecosystem service, imposing along the way a burden in terms of implementation and monitoring that exemplifies a trade-off between precise, prescriptive measures and the associated transaction costs.

The outcomes of agri-environmental schemes at a landscape scale can vary significantly depending on whether they prioritise habitat or species-based metrics. The UK case study used modelling to compare the outcomes of spatial targeting and non-spatial targeting. The spatial targeting intended to capture the spatial heterogeneity in biodiversity outcomes associated with pre-defined farm management actions. For the same budgetary cost, there was a marginal improvement in the species-based metric.

Overall, effective communication and engagement with farmers are important to mitigate opposition and ensure the success of spatially targeted conservation efforts.

Further information:

- *Do agri-environment measures help improve environmental and economic efficiency? Evidence from Bavarian dairy farmers.*
- *Effect of agri-environment schemes (2007–2014) on groundwater quality: spatial analysis in Bavaria, Germany*

7. DIFFERENTIATING PAYMENTS CAN IMPROVE ENVIRONMENTAL EFFECTIVENESS, BUT CAN RAISE FAIRNESS CONCERNS

Varying payment structures can encourage the adoption of environmentally friendly practices in impactful areas. In the pursuit of cost-effectiveness, linking payment levels to specific spatial zones can significantly reduce the budgetary burden on the agency responsible for achieving environmental goals (see item 6).

Furthermore, the design of contracts allowing differentiation of farmers based on the selection process was examined in both the Schleswig-Holstein and Danish cases. In Schleswig-Holstein, experimental investigations explored the use of auction mechanisms to promote biodiversity conservation in various agricultural landscapes; while in Denmark the efforts to enhance environmental effectiveness via agency selection procedures were explored using Data Envelopment Analysis. The findings indicated that, within a fixed budget, offering higher payment rates can improve environmental effectiveness and simultaneously target multiple environmental policy objectives.

From a theoretical perspective, results-based payments are one way of differentiating payments between areas and are often considered to be more cost-effective than action-based payments. However, a key concern of payments for results is that such schemes transfer risk from the buyer (the government) to the seller (farmers), when farmers cannot be sure that a particular set of actions will deliver a particular result, due to factors outside of their control (e.g. weather factors).
In cases where there is limited flexibility and a similar payment, farmers might prefer action-based payments over result-based ones due to concerns about uncertainties, as observed in the Dutch and Bavarian contexts (see lesson 3).

Modelled results, on the other hand, rely on predictive models that incorporate various variables and scenarios. This improves spatial allocation of payments, based on expected results. The UK case study provided the first empirical test of the economic and ecological consequences of applying such a payment for modelled results policy

to farmland biodiversity in England. It compared payment for modelled results findings with approximately equivalent payment for actions schemes designed to deliver increases in the same biodiversity indicators. Key insights from the work are that payment for modelled results delivers superior ecological outcomes for the same budgetary cost as payment for actions, whilst economic surpluses to farmers are also higher. In general, payment for modelled results may address various challenges perceived with traditional results-based schemes in agri-environmental programs: reduced uncertainty, cost efficiency, flexibility and scalability, reduced risk of free-riding. However, traditional results-based schemes have the advantage in that they have the potential to utilise farmers' local knowledge to increase provision of environmental goods. Real-world experimentation with this payment modality based on modelled results thus seems highly recommendable, so as to gain on-the-ground insights.

However, differentiated payments also add to complexity. Complex payment structures may discourage participation among farmers who may find it challenging to navigate a multitude of payment criteria and requirements. Differentiated payments can sometimes also lead to concerns of inequity or unfairness. Farmers in regions or circumstances receiving lower-tier payments may feel unfairly treated, which can lead to opposition or reduced buy-in for the programme.

Effective knowledge exchange and transfer are particularly crucial when payments depend partially or entirely on outcomes.
This exchange can occur vertically, between advisors and farmers, and horizontally, through farmer-to-farmer interactions.

Further information:

- *Improving the ecological and economic performance of agri-environment schemes: Payment by modelled results versus payment for actions.*
- *Tradeable Nitrogen Abatement Practices for Diffuse Agricultural Emissions: A 'Smart Market' Approach.*

8. ENVIRONMENTAL SELF-MONITORING CAN CREATE BUY-IN AND A SENSE OF RESPONSIBILITY BY LOCAL STAKEHOLDERS, BUT IT CAN LEAD TO UNDERESTIMATION OF MONITORING COSTS

The conventional approach has typically placed the responsibility for compliance monitoring on public agencies. However, our study cases have demonstrated alternative methods, **such as intermediaries and environmental volunteers**, as well as the **promotion of self-monitoring by farmers**, often accompanied by random checks conducted by authorities, in accordance with CAP regulations.

The adoption of self-monitoring measures by farmers fosters a sense of responsibility and can increase their participation.
This is also the case for Bavaria, where farmers expressed a willingness to forego significant shares of AES payments for the permission to self-monitor. Similarly, in Romania contractual obligations entailed self-monitored recordings of indicator species and periodic on-site checks. In Schleswig-Holstein and the Netherlands, volunteers from bird-watching organisations assumed the role of monitoring compliance, facilitating constructive communication with farmers, while in Romania the result-based pilot scheme provided a hired expert's services to help farmers

with self-monitoring, which suggests that third-party monitoring might be part of the contract design.

Self-monitoring may, however, reduce the net value of the payments and generate extra administrative burdens for farmers. Baseline management actions, supported through compensation payments (e.g. income forgone due to prohibition to use chemicals and fertilizers) may be complemented by voluntary provision of agri-environmental services measured in units, e.g. number of indicator species, number of birds' nests, area not mowed to allow natural sowing, etc.

9. CHANGING THE DESIGN OF AES CAN SHIFT TRANSACTION COSTS BETWEEN THE PARTIES INVOLVED

Transaction costs represent a significant aspect of various phases within agri-environmental schemes, impacting both farmers and public agencies. Traditionally, farmers incur transaction costs during the application phase, while public agencies have transaction costs associated with designing, contracting, compliance monitoring and (potentially) sanctioning. However, in the Netherlands, a shift from individual to collective contracts resulted in a transfer of transaction costs – among others for contracting with individual farmers – from public authorities to farmer collectives. Also, monitoring transaction costs were to a large extent transferred to collectives and volunteers in the field, although some public monitoring expenses remained due to public monitoring requirements that are mandatory for justifying CAP payments. Future research needs to show whether this transaction cost shift will also decrease transaction costs overall.

Further information:

- *A conceptual framework for measuring transaction costs in agri-environmental schemes: an application to the Dutch collective scheme.*

10. TECHNOLOGICAL ADVANCEMENTS AND DIGITAL TOOLS CAN REDUCE TRANSACTION COSTS IN THE IMPLEMENTATION OF AES

Technological advancements have presented opportunities for cost-effective monitoring. In the Netherlands, for instance, drones were deployed to identify mating bird pairs, a crucial indicator for results-based monitoring. In Estonia, a public GIS-tool has been introduced to facilitate the spatial information exchange between rural land users (CountrysideGIS). The tool combines maps from different state departments and databases with satellite images. Information-seeking transaction costs are reduced with this tool for both beekeepers and farmers. Beekeepers can extract information from the tool about flowering crops (view an example) and crop predictions for the next season (view an example). Farmers can assess the state of their crops, and the location and number of nearby honeybee hives, as well as contact information for beekeepers. A GIS based tool has also been introduced in Romania to monitor the use of land under AES.

Further information:

- *Precision farming at the nexus of agricultural production and the environment*
- *Agricultural policy in the era of digitalisation.*

11. COMPETITIVE BIDDING MECHANISMS OFFER POTENTIAL TO ENHANCE THE COST-EFFECTIVENESS OF AES, BUT THEY DON'T GO WELL WITH COLLECTIVE APPROACHES

Theoretical analysis suggests that competitive bidding for conservation contracts can be a powerful means for conservation agencies to increase

the effectiveness of allocating public spending for the provision of environmental benefits. The outstanding feature of conservation auctions is their potential to reveal, at least partly, bidders' compliance costs, thereby reducing the information asymmetry between landholder and agency. Conservation auctions also act as a price discovery mechanism for environmental goods and services which have no standard value and which are difficult to cost. They thus allow the parties to deal with the uncertainty about the value of the object being traded. Conservation auctions are the main mechanisms for allocating conservation contracts in the US and in Australia, where the value-for-money approach is more ingrained than in the EU. In terms of cost-effectiveness, bidding schemes yield the highest benefits when the conservation agency has little information about landholders' compliance costs, the number of potential participants is large, the contracts offered are homogeneous, and farms are heterogeneous in their compliance costs. The fewer of these conditions apply, the less auctions will be able to outperform fixed-rate payments. Evidence from controlled lab experiments suggests potential cost savings of approximately 30% when an auction is used to allocate conservation contracts, and this is backed up by evidence from outside the EU. Bidder learning poses a substantial threat to the efficiency of multiple-round conservation auctions.

Both experimental studies and agent-based simulation studies have confirmed the experience with the US Conservation Reserve Program: when bidders have the opportunity to learn from preceding bidding rounds, they will use that information to update their bids and reap a higher share of the 'surplus' – to the detriment of auctions' 'performance surplus'. The potential benefits of auctions come at the cost of likely higher administration costs and higher transaction costs on the side of landholders, although empirical evidence has been patchy so far. The costs of preparing and submitting bids can act as a deterrent to participation. Auctions introduce competition between farmers in the provision of public environmental benefits. This does not sit well with the equal treatment mentality in the EU and the trend towards collaborative approaches in the EU's agri-environmental policy, although auctions can also be seen by farmers as more customised to individual opportunity costs, and thus more equitable.

In EFFECT, we conducted controlled economic experiments to study the performance of conservation auctions which were augmented with incentives for spatial coordination of conservation efforts. One key finding is that an Agglomeration Bonus (AB) embedded in an auction will enhance spatial coordination only in landscapes where farmers' compliance costs and environmental benefits are positively correlated, i.e., where high-natural-value land is costly to put under conservation management. In landscapes where costs and benefits are negatively correlated or uncorrelated, the AB turned out to be counterproductive. Across all landscape types, the AB reduced the cost-effectiveness of the AES under consideration. These findings reinforce the above statement that competitive approaches (auctions) do not go well with implementation models that require collaboration among farmers.
Competitive bidding to achieve landscape-level environmental targets was also explored using an integrated ecological economic model for the Danish case study. The analysis showed significant cost reductions, but relies on spatial coordination through a central planner to achieve cost-effective outcomes.

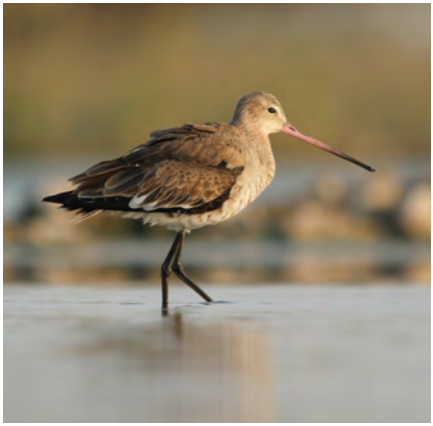
Further information:

- *Tradeable Nitrogen Abatement Practices for Diffuse Agricultural Emissions: A 'Smart Market' Approach.*
- *Water quality trading markets – Integrating land and marine based measures under a smart market approach.*

5.

Guiding AES design choices

As outlined in the previous sections, voluntary agri-environmental policies in Europe have historically been based on individual practice-based support schemes. However, there is not always a 1:1 correlation between the practice and the effect, which has led to a growing interest in result-based schemes. Furthermore, there is a growing interest in collective agreements. This is because environmental effectiveness often requires the participation of more than one landowner, or at least for some ecosystem services it is more effective if neighbouring farmers coordinate their environmental efforts. Both results-based schemes and collective schemes were at the core of the EFFECT case studies, with some combining elements of both approaches, or following innovative designs. The following explanations therefore revolve around main aspects of action-/result-based schemes and individual/collective schemes, including other aspects such as targeting or payment mechanisms.



It is not in itself an advantage that schemes are either collective vs. individual. Similarly, a result-based scheme is not guaranteed to produce greater or lesser impact than a practice-based one.
There may be perverse incentives in both an individual activity-based scheme, a result-based scheme and a collective scheme; thus no one type of scheme is generally better than another. The choice depends on the AES purposes, natural characteristics of the region where it is implemented, and some scheme-specific characteristics, including the availability and nature of private information of the farmer and the implementing agency or intermediary.

The choices between activity- and results-based and between individual versus collective are not standalones; in the overview shown in the table below, we include spatial targeting and differentiated payment mechanisms as other key design choices that implementers should consider.

Our case-derived AES observations generally remind us of the significant tradeoffs that exist between farmer concerns (uptake and welfare) and environmental objectives (impacts and cost-effectiveness), although some 'smart' (incl. hybrid-type compromise) design options may also exist to effectively bridge these tradeoffs.

	Farmer uptake	Farmer welfare	Environmental impact	Cost-effectiveness
Action-based	Secure payment	Predictable income	Indirect link to ES	Less ES delivered Low-cost monitoring
Result-based	Higher risk More flexible management	More effort and risk Local knowledge integrated	Direct link to ES	More ES delivered Expensive to monitor
Individual scheme	More predictable	More predictable rise, individualism	Low ES contiguity	More contracts, more transaction costs
Collective schemes/ Partecipation bonuses	Transaction costs added vs bonus paid	Joint coordination, bonus paid but free-riding risk	High ES contiguity	Fewer contract costs Bonus costs. Higher costs for collectives
Spatial targeting of eligible farmers	Fewer farmers participate	Some farmers not eligible - can be perceived as unfair	Increased ES	More value for money Added targeting costs
Differentiated payments mechanisms	Agency co-determinates uptake	Reduced rents	Increased ES	More value for money Added targeting costs

Overview of key design considerations green positive/ red negative results or perceptions. Black text is for neutral features.

EFFECT

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