Farmer Clusters for Realising Agrobiodiversity Management across Europe

Review of existing public incentive schemes plus design options

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Deliverable Description & Contributors

- **Due date**: September, 30th 2022
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- **Work package leader**: Prof. Dr. Stefanie Engel (UOS)
- **Deliverable Title**: Review of existing public incentive schemes plus design options
- **Nature of deliverable**: Report
- **Dissemination level**: Public

- **Deliverable description:** The Deliverable investigates how farmers in selected FRAMEwork clusters utilise agri-environment schemes (AES) to achieve their cluster goals. Further, innovative AES designs incorporating result-based payments and collective incentives are identified, presented, and discussed in light of their potential to support the selected FRAMEwork clusters and the cluster concept more broadly.

- **Contributors**
  - Writing and revising: Thomas Rellensmann, Stefanie Engel, Fabian Thomas, Moritz Fritschle (UOS)
  - Data collection: HUTTON, GWCT, GRAB, BOKU, EMU, AREC, FA, SSSA, INRAE, UVA, LIST, CULS, TAL

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1. Background to the FRAMEwork project

1.1. FRAMEwork Project Executive Summary *(abbreviated)*

Biodiversity is essential for agroecosystem resilience, sustainability, and long-term food security. Traditionally, management for short-term economic returns has taken priority over management for the environment. Current mechanisms for compensating and encouraging farmers to apply biodiversity sensitive management strategies are often inefficient, being applied at individual farm rather than landscape level, and tend to be generic solutions, imposed from the top down at an EU or national level. Monitoring is rarely carried out and there is therefore little scope for evaluating the success of strategies in achieving improvements to farmland biodiversity.

The FRAMEwork project has been designed to develop a novel alternative to this called the **FRAMEwork System for Biodiversity Sensitive Farming** to enable the transition of EU farming systems to a position where they can conserve biodiversity and benefit from the enhancement of ecosystem services, while mitigating agronomic or economic risks. The FRAMEwork System combines the following elements:

- **Advanced Farmer Clusters** – local farmer groups working as a collective to deliver landscape scale management, supported by a Cluster Facilitator with expertise in agriculture and the environment, and linked to a local Cluster Stakeholder Group to inform and promote policy and practice, organised into regional, national, and international networks.
- **Technical Resource** – technical specialists associated with the regional, national, international networks to provide technical information, methods, and tools to support agrobiodiversity monitoring, management and policy including the dedicated DSTs – FRAMEselect and FRAMEtest.
- **Scientific Innovation** – researchers associated with regional, national, international networks to provide knowledge on the ecology, sociology and economics that underpins the functioning of sustainable agricultural systems.
- **Citizen Observatory and Information Hub** – an open access platform to support FRAMEwork networks, sharing activities, information, data and resources between farmers, scientists, policy makers, and citizens.

The FRAMEwork project will design, build, test, and deploy a prototype of the FRAMEwork System for Biodiversity Sensitive Farming and will work with three concepts important to the success and delivery of the project: (i) promoting collective landscape management; (ii) applying the approach across a diversity of European farming systems; and (iii) understanding and supporting the social and ecological change associated with a transition to biodiversity sensitive farming.

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1.2. Project Partners

No	Participant organisation name	Type	Country
1*	The James Hutton Institute (HUTTON)	Research Inst	UK
	Game and Wildlife Conservation Trust (GWCT)	Non-profit	UK
3	Groupe de Recherche en Agriculture Biologique (GRAB)	Non-profit	FR
4	Universitaet fuer Bodenkultur Wien (BOKU)	University	AT
5	Eesti Maaulikool (EMU)	University	EE
6	Hoehere Bundeslehr- und Forschungsanstalt fuer Landwirtschaft Raumberg-Gumpenstein (AREC)	Research Inst	AT
7	Fundacion Artemisan (ARTEMISAN)	Non-profit	ES
8	Scuola Superiore di Studi Universitari e di Perfezionamento Sant'anna (SSSA)	University	IT
9	The University of Hertfordshire Higher Education Corporation (UNI OF HERTS)	University	UK
10	Centro de Investigacion Ecologica Yaplicaciones Forestales Consorcio (CREAF)	University	ES
11	Institut National de la Recherche Agronomique (INRA)	Research Inst	FR
12	Internationales Institut fuer Angewandte Systemanalyse (IIASA)	Research Inst	AT
13	Universiteit van Amsterdam (UvA)	University	NL
14	Luxembourg Institute of Science and Technology (LIST)	Research Inst	LU
15	Universitaet Osnabrueck (UOS)	University	DE
16	Taskscape Associates Limited (TAL)	SME	UK
17	Ceska Zemedelska Univerzita v Praze (CULS)	University	CZ
18	Nordisk Fond for Miljo og Udvikling (NORDECO)	SME	DK

*Coordinating institution

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1.3. Purpose of the Deliverable

This Deliverable examines agri-environment schemes (AES) as a major instrument for farmers to receive monetary compensation for voluntarily adopting environmentally-sensitive farming practices. AES are offered to farmers in all FRAMEwork cluster countries, as they are a mandatory requirement for all Member States of the EU. However, they differ in terms of their organisation, prescriptions, and underlying incentive mechanisms. This Deliverable examines how selected FRAMEwork clusters use the AES available in their country. Further, it investigates how traditional AES designs might be adapted to provide more distinct support for the FRAMEwork farmers and to align with the cluster concept of landscape-scale management. For this, the report revisits and considers the theoretical, empirical, and experimental literature on innovative scheme designs including result-based payments and the incorporation of collective incentives. The Deliverable will allow to subsequently design, test, and ultimately realise promising AES designs to equip farmers across the EU with a supportive incentive framework that promotes biodiversity-sensitive farming in the FRAMEwork System.

2. Introduction

The European Union's Common Agricultural Policy (CAP) includes various tools to attenuate the impact of modern intensive farming on the natural environment. Among these are so-called agri-environmental schemes (AES). AES provide compensation to farmers who voluntarily adopt environmentally-sensitive farming practices on their land that go beyond the national or regional baseline requirements (Science for Environment Policy, 2017). AES are developed and administered by the national or regional authorities and mandatorily offered to the farmers in each member country of the EU. Whether or not farmers participate in the programmes, however, is their own choice. As such, national AES present a major source of funding to realise conservation activities within the FRAMEwork piloting clusters.

This report examines (i) the interaction of FRAMEwork clusters with the available public incentive schemes in the clusters' regions and (ii) the degree to which conventional AES support the farmer groups in the realisation of their environmental objectives. Particular attention is paid to the potential of AES (current or future) to promote landscape-scale agri-environmental management in line with the vision of the FRAMEwork System for Biodiversity-Sensitive Farming. Innovative approaches for AES design are identified, presented, and discussed. These approaches base compensation payments on ecological evidence instead of top-down management prescriptions (*i.e.,* result-based AES) and actively promote concerted conservation efforts across individual farms (*i.e.,* collective AES). Finally, the report highlights avenues for further research and experimentation to provide farmer clusters across the EU with a policy framework that incentivises and promotes landscape-scale collective action for agri-environmental conservation.

The remainder of this report is structured as follows. Section 3 summarises the surveys conducted that provide the data for the analysis. Section 4 presents this data by investigating how FRAMEwork clusters make use of public schemes and whether the applied schemes align with the groups' environmental objectives. Section 5 provides an extensive overview of potential innovative AES designs to support the cluster approach. This includes the published theoretical, experimental, and empirical evidence as well as a collection of real-world applications. The section further adds to this review by providing an indication of whether the considered innovative AES designs might present a feasible and promising complement to the existing incentive structure in the cluster context. Section 6 concludes the report.

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3. Data

This report utilises multiple sources of data. This includes survey data collected for different tasks of the work package as well as findings from a review of the literature and an in-person session at the General Assembly project meeting in Luxembourg in May 2022.

3.1. Farmer 'Before'-survey

As set out in Task 6.1b, a survey was conducted with the farmers in a subsample of FRAMEwork clusters (AREC, CULS, EMU, GRAB, SSSA, LIST, UVA) between March 2021 and February 2022. The survey was pre-tested in a FRAMEwork piloting cluster and the feedback obtained was used to revise the final version, which was then distributed to the clusters. The survey collected quantitative and qualitative data related to farmers' self-identity, environmental attitudes, their perception of the cluster, their use of public agri-environmental funding, as well as former experiences with collective action. The survey will be repeated at the end of the project to examine if and how cluster membership promotes a conservationist or pro-social identity dimension in farmers. The survey was initially programmed and distributed online. Additionally, some clusters handed in a paper version to adapt to farmers' heterogenous preferences. The table on the right summarises the resulting response rate of the 'before'-survey.

Cluster Country (Partner)	No. of farmers	Responses
Austria (AREC)	12	12 (100 %)
Czech Republic (CULS)	10	4+2 (60 %)
Estonia (EMU)	11	6 (55 %)
France (GRAB/INRA)	10	5 (50 %)
Italy (SSSA)	16	8 (50 %)
Luxembourg (LIST)	5	0 (0 %)
Netherlands (UVA)	8	7 (88 %)
TOT	**72**	**44 (61 %)**

3.2. Survey of Cluster Leads and Facilitators

A second survey was conducted to determine the clusters' use of and interaction with public and private incentives prior to a project meeting in Luxembourg in May 2022. The survey was pre-tested with a cluster facilitator and sent out electronically in April 2022 to the project cluster leads (*i.e.,* not farmers, but project partners closely associated with the clusters). The cluster leads and facilitators then filled out the survey jointly. The survey asked for characteristics of public funding schemes offered in the cluster's area (*e.g.,* targeted farming systems and ecosystem services, eligibility requirements, conditionality of payments, funding length) and which AES were perceived as particularly valuable or missing to support the cluster's efforts. The second part of the survey focused on respondents' knowledge about and use of private incentives (*e.g.,* labelling, direct marketing strategies, retailer standards, self-organised incentives). The findings of this second part are presented in Deliverable D6.3.

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This data collection exercise proved challenging as cluster facilitators and leads were under great time pressure, which impeded the timely submission of the survey. Furthermore, they expressed a frequent lack of knowledge about both the AES available and the actual schemes used by the farmers. Thus, many clusters were not able to answer the survey fully. This lack of survey data was compensated for, as best as possible, by one-to-one enquiries during the General Assembly meeting, email exchanges and own investigation of the AES available.

Section A.2 and A.3 in the Appendix collate the survey questions that were analysed for this report.

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4. Farmers interaction with AES in FRAMEwork piloting clusters

This section examines the cluster farmers' use of and interaction with public agri-environment schemes. In accordance with the other project tasks that are part of this work package, we include the selected four case study clusters (Czech Republic, Austria, United Kingdom, Netherlands) as well as further piloting FRAMEwork clusters that participated in the 'Before'- and 'Facilitator' survey (Estonia, France, Italy, Luxemburg). This allowed for the insights generated in the previous tasks to be built on and expanded, and to potentially inform the process of selecting suitable study sites for the (economic) experiments of Tasks 6.3 and 6.4. The following subsections briefly present the farmer clusters, their use of AES funding and information on particular AES programmes that the facilitators or cluster leads deemed important for their groups. The latter is additionally summarised in the Appendix A.1.

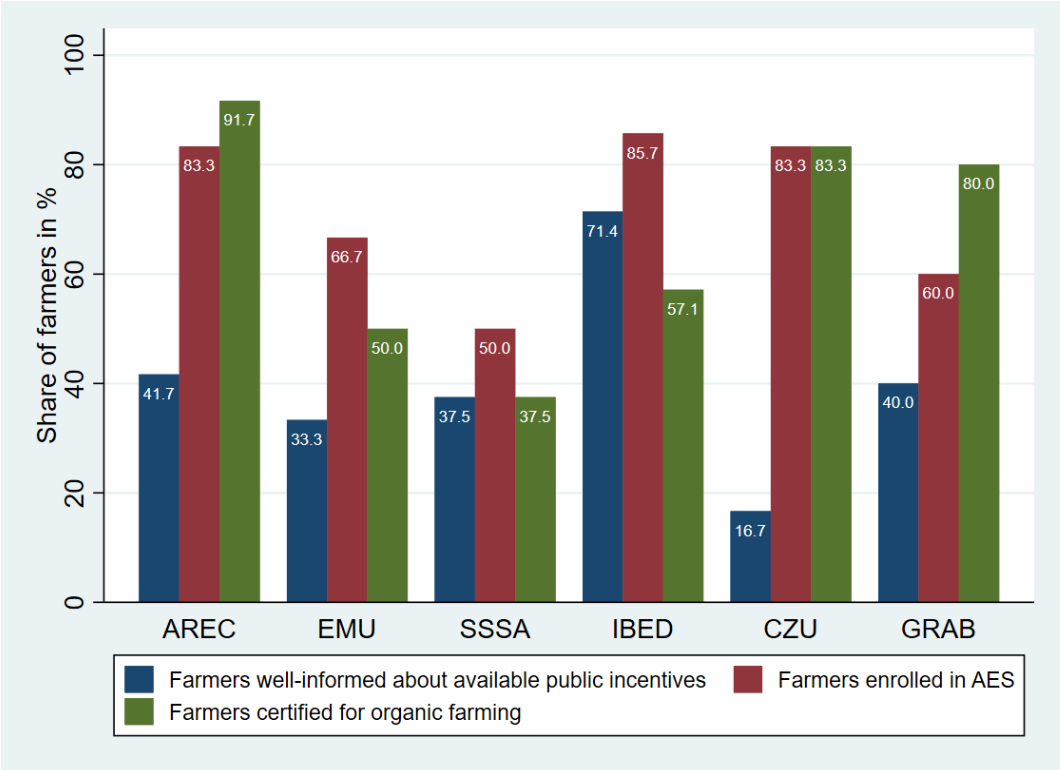

Figure 1. Proportion of farmers who feel well-informed about available public funding options, are enrolled in AES and certified for organic farming in the Austrian (AREC), Estonian (EMU), Italian (SSA), Dutch (UVA), Czech (CULS) and France (GRAB) clusters.

Austria – AREC

The Austrian cluster is composed of 12 member farms with on average 20 ha of agricultural land. Located at the eastern foothills of the Alps, the cluster area primarily comprises extensively managed grassland. Cluster objectives focus on re-establishing traditional high plant and insect biodiversity on their members' meadows.

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With a share of 83 % (and a 100 % response rate in the survey), the AREC cluster exhibits one of the highest enrolment rates in AES of all clusters examined for this report. This is linked to the fact that all AREC members are organic farmers. As such, they are eligible for the Organic Farming scheme of the Austrian ÖPUL programme (M11, "Biologische Wirtschaftsweise") that compensates farmers for complying with European organic farming standards. Furthermore, most farmers participate in the "Valuable areas" option of the "Nature Protection" scheme ("Naturschutz"). This option aims for the enrolment of environmentally beneficial agricultural lands and compensates farmers for restraining from intensifying agricultural practices. As an optional measure, farmers can participate in local environmental initiatives that implement cross-farm nature conservation plans. However, it is not known to the authors whether FRAMEwork clusters participate in these initiatives.

Finally, many farmers are reported to use their meadows for dairy cattle and are enrolled in an associated animal welfare ÖPUL option that rewards pasture grazing (on at least 120 days of the year) ("Tierschutz-Weide", M14). Overall, survey results indicate high levels of satisfaction with the currently available AES options. Furthermore, survey respondents highlighted additional biodiversity measures that will be introduced within the new ÖPUL funding period starting in 2023.

A striking finding in the AREC case is a strong divergence between farmers' high enrolment rate in AES and farmers' stated level of knowledge about the public incentives available in their region (83 % vs 42 %). A potential explanation for this deviation may lie in the high involvement of the cluster's facilitator (or agricultural advisors in general) in helping farmers to identify suitable scheme options to apply for. This hypothesis is just partly confirmed based on the survey results. Only five farmers (out of 12) indicated that they make use of government advisory services or private consultants to help them with decision-making related to farm management. An alternative explanation may be that the available scheme options align particularly well with the cluster farmers' management style, thus rendering detailed examination of other scheme options (*i.e.,* 24 in the ÖPUL programme) unnecessary.

Czech Republic – CULS

Ten farmers are part of the Czech farmer cluster, with an average farm size of 313 ha. Managing mostly arable land such as cereals, the Czech cluster is more centred in the realm of traditional agricultural production compared to the AREC cluster. The primary conservation goals of the group include the protection of birds of prey, enhancing soil fertility and earthworm abundance and preventing erosion.

With an 83 % enrolment rate (five farmers out of six), the Czech cluster makes wide use of AES funding. Four farmers did not respond to our survey and their enrolment thus remains unknown. However, given that all members of the Czech cluster are organic farmers, it is assumed that the majority of Czech cluster farmers is enrolled in the Czech organic farming

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programme ("M11 Ekologické zemědělství (EZ)"). This program was also mentioned as the most important scheme for the cluster by the Czech facilitator.

In addition, cluster farmers are reported to make wide use of an AES sub-measure that rewards the establishment of bio corridors, *i.e.,* stretched patches of land (6-24m of width and minimum 30m of length) that are mostly left to fallow (AEKO sub-measure "Biopásy"). Farmers under this scheme are required to sow a biogas-suitable seed mixture on the bio corridor patches (including spring cereals, millet, buckwheat, and fodder cabbage) and to leave the area untouched most of the time of the year (apart from mowing and biogas production). The bio corridors are expected to provide shelter and migrating paths for invertebrates and small field animals. Consequently, they also present attractive food offers for birds. And finally, they help regenerating the soil and rebuild soil micro-organism biodiversity that promotes the co-creation of structural soil on adjacent cultivated land. One cause for frustration of farmers linked to this scheme option was mentioned by the Czech facilitator: prohibiting the passing of bio corridors with agricultural machinery poses logistic challenges to some farmers who wish to use the bio corridors for transporting.

Another potentially attractive scheme option for the Czech cluster is the sub-measure "**M16 Cooperation**", which provides funding for projects aiming to strengthen research, technological development, and agricultural innovation. The Czech facilitator voiced interest in using this scheme to access funding for cross-farm landscape-scale management or cooperative efforts such as sharing of machinery or other inputs. However, the cluster is not yet using this scheme due to a lack of experience and knowledge regarding its requirements and the administrative process involved.

Only one farmer in the cluster stated to be well-informed about existing public funding schemes, suggesting again that farmers' enrolment in AES might be primarily guided through external sources of knowledge. However, the survey data does not support this hypothesis, as no Czech farmer is reported to use governmental advisory services and only one farmer stated to receive advice from private consultants. Instead, farmers frequently receive advice from other farmers (mentioned by four out of six farmers). This indicates that farmers might enrol into schemes that their neighbouring farms also apply for, thus offering a potential complementing explanation for the high AES enrolment rate observed.

Estonia – EMU

The Estonian cluster (11 members with, on average, 317 ha of agricultural land) is relatively heterogenous in the farming systems employed. Some farmers cultivate cereals, while others manage grassland and sheep meadows both with and without organic certification.

Four farmers (out of six who answered the survey) stated that they use AES funding, whereas three farmers in the sub-sample are certified for organic production. The cluster objectives vary, with some members voicing particular interest in bird protection whilst others target

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farmland biodiversity (pollinators and other insects, wildlife, vegetation, *etc.*) more generally. The Estonian facilitator reports two schemes that are particularly valuable for the group.

First, farmers who are not certified for organic farming utilise a scheme that rewards general environmental measures set below the requirements for organic farming (Environmentally-friendly management, "Keskkonnasõbraliku majandamise toetus"). Scheme requirements include the diversification of crop cover, temporal crop rotation, growing of leguminous crops on parts of the lands, maintaining a winter cover of arable crops, participation in environmental management training and sound use of fertilisers and pesticides. Optional funding is available for additional, voluntary actions for water protection, establishing apiaries or promoting farmland birds. Overall scheme objectives are (i) the promotion of environmentally sound agricultural management, (ii) the enhancement of biodiversity and landscape diversity and (iii) raising farmers' environmental awareness.

Second, several farmers in the cluster who cultivate permanent crops or grassland on peat soils are enrolled in a 'Regional Soil Protection' scheme ("Piirkondlik mullakaitse toetus"). The scheme offers landholders of peat-rich or eroded and eluvial soils compensation payments for maintaining permanent grass cover to reduce further erosion, nutrient leaching and promote the agglomeration of organic matter in the soil.

The cluster facilitator and lead report two schemes missing to support cluster objectives. First, they would approve of a scheme that targets the agricultural landscape as a whole instead of being restrained to the individual farm level. And second, they miss a scheme that supports farmer-led initiatives instead of focusing on top-down management prescription.

In line with the findings described for the Austrian and Czech clusters above, only two Estonian farmers indicated high levels of knowledge about available AES. In contrast to the previous clusters, however, the Estonian farmers more regularly receive advice from governmental bodies (four out of six farmers). They are again highly influenced by their farming community, as five farmers indicated that they seek management advice from other farmers.

France – INRA/GRAB

The ten farmer members of the French cluster manage apple and pear orchards with an average size of 55 ha. The primary objective of the cluster is the realisation of integrated pest management to reduce the need for pesticide application. The farmers aim to promote the abundance of species that function as natural enemies for orchard pest infestations, including birds, bats, arthropod predators (such as spiders, earwigs, hoverflies), voles and codling moths. Six farms in the cluster are certified for organic farming.

Three out of five farmers responding to our survey indicated AES enrolment, resulting in a participation rate of 60 %. A practical barrier for this analysis emerged as no project personnel was able to provide information on the AES that the cluster members use. Given the existence

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of organic farms in the cluster, it can be assumed that at least some of the farmers might be enrolled in an organic farming scheme. However, four farmers in our sub-sample indicated certification for organic farming whereas only three applied AES, suggesting that organic farming practices do not necessarily entail enrolment in an associated scheme. Given the lack of more detailed information on the cluster's use of AES, a thorough examination is not possible. Only two farmers reported high levels of knowledge concerning available AES, thus continuing the trend depicted above.

Italy – SSSA

A similar situation to the French case emerged in the Italian cluster. The Italian group comprises 16 farmers, all of whom manage olive groves with a relatively small size of on average 2 ha. As in the French cluster, the main concern for the Italian group presents pest infestations by the olive fruit fly. Therefore, cluster efforts are substantially motivated by the desire to establish a natural population control by promoting the abundance of spiders, carabids and parasitoid wasps. Additionally, the cluster aims to support wild bees and butterflies as a broader conservational objective.

Of eight farmers who answered our survey (response rate of 50 %) only four stated to be enrolled in an AES at the moment and three farmers reported organic certification. The relatively low AES enrolment rate is confirmed by the cluster's facilitator and cluster lead. Both reported limited use of public funding due to a) a lack of AES targeting olive groves in the region of Tuscany, and b) hobby farmers in the cluster not being allowed to receive public funding via AES. For that reason, no AES were mentioned to be particularly valuable for the cluster.

Interestingly, the level of knowledge about available AES was similar to the other clusters presented before (only three out of eight farmers, *i.e.,* 38 %, indicated good knowledge of the AES offered), suggesting that actual AES enrolment is no reliable predictor of farmers' knowledge levels. Overall, the Italian cluster's use of and interaction with AES funding appears to be rather limited.

Luxembourg – LIST

Six farmers are members of the Luxembourgish cluster located at the Western border to Germany (average farm size approximating 80 ha). All members extensively manage apple, quince, and plum orchards with traditional fruit tree varieties that are primarily used for the production of cider. Additionally, cattle (primarily Limousine cows) are held on the orchards for low-intensity grazing. In line with their economic orientation, the cluster is mainly interested in pollinators such as butterflies, wild bees (including bumblebees) and honeybees.

No farmer responses to our survey were received from the Luxembourgish cluster, and the specific enrolment rate thus remains unknown. However, the cluster lead and facilitator report that two AES options are widely used by the cluster farmers.

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The first is specifically tailored towards the conservation and maintenance of traditional orchards ("Förderung von Streuobstwiesen"). The scheme grants conservation payments if orchards are managed without mineral or organic fertiliser application or broad-scale herbicide use. It is particularly valuable for the cluster as it allows the removal of the parasitic plant *Viscum Album* from the trees, which is said to appear at epidemic levels in the region. *Viscum Album* especially endangers old fruit trees.

The second scheme promotes extensive management of grassland in areas that are critical for the supply of drinking water ("Extensivierung von Grünland"). Scheme requirements mainly include the banning of plant protection products, forbidding the installation of new drainage systems, maintaining a winter cover (no pasturing during winter), defining maximum densities of cattle (and associated manure) on the meadows and finally the obligation to take part in an agri-environmental advisory session.

Some cause of frustration linked to AES participation has been documented in this cluster, in that AES requirements sometimes are not in line with the requirements faced in orchard management. Furthermore, farmers are reported to experience conflicts between schemes, as a farmer participating in one scheme might lose funding when joining another. This is confirmed and elaborated by the cluster lead, explaining that many members voiced interest in joining a scheme that targets extensive grazing of dairy cows. The scheme requires permanent cattle grazing on the meadows, which is explicitly not allowed for the extensive grassland management scheme described previously. This prevents farmers from enrolling in both schemes. Notably, this is likely not a symptom of deficient scheme design, but on the contrary an intentional measure to avoid double funding. Thus, it follows EU ruling that does not allow the costs for the same activity to be funded twice from the EU budget.[1] Survey data indicates that neither the LIST farmers nor the facilitator are aware of this rule. The arising frustration is thus primarily a consequence of lack of knowledge.

Netherlands – UVA

The Dutch farmer cluster contains eight members in the region of Flevoland, managing on average 50 ha of arable land for the production of (among others) potato, onion, wheat, sugarbeet, carrot and bulbs. The group's environmental objectives are widespread and include the promotion of natural enemies of pest species, soil health (particularly earthworms and other soil organisms), pollinators and farmland birds.

Seven farmers answered our survey (response rate of 88 %), of which six participate in AES programmes (86 %) and four are certified for organic farming (57 %). Cluster farmers are reported to be enrolled in four different AES options that all target farmland birds. More specifically, they implement field margins to promote farmland birds in general ("Kruidenrijke akkerrand") or the skylark particularly ("**Veldleeuwerikrand**"), or designate arable field areas

[1] Article 111 of Council Regulation No 1605/2002 of 25 June 2002 on the Financial Regulation applicable to the general budget of the European Communities.

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for bird foraging, resting, and breeding ("Wintervoedselakker" and "Vogelakker"). A particularity of the Dutch case is that AES contracts are not administered by the national authorities, but by so-called agri-environmental collectives (AECs). AECs are collective bodies that bundle all agricultural landholders or -managers of the Dutch provinces and allocate individual AES contracts and funding on behalf of the Dutch Ministry of Agriculture (see further section 5.2.1 or Boonstra et al., 2021). The AEC for the Dutch cluster is the 'Flevolands Agrarisch Collectief' (FAC). The FAC holds 103 members and presents the smallest AEC in the Netherlands in terms of membership numbers (Boonstra et al., 2021, p. 24). The AES used by the Dutch cluster farmers prescribe management actions that need to be implemented by individual farmers to receive funding.

The '**Vogelakker**'-option defines crops to cultivate, restrictions for the use of chemical weed control and fertilisers, and detailed management instructions regarding the timing of sowing, grubbing, mowing, and harvesting activities. For the '**Kruidenrijke akkerrand**' option (Eng. 'herb-rich field margins'), requirements are not predefined on a national level, but instead set by the Collective (the FAC). FAC develops a management plan for the cultivation of field margins, including the specification of the herbs that are sown and associated management practices (frequency and timing of mowing, ploughing, and reseeding). It has not been reported whether cluster farmers' have a say in the development process of the management plans. However, the large membership number of the Flevoland AEC suggests that farmers' degree of involvement is likely limited.

It is noticeable that the Dutch cluster is exclusively enrolled in AES promoting farmland birds, whereas no public funding is accessed to realise other reported group objectives. Reasons for this one-sided use of AES have not been provided in the survey. They might include either a lack of suitable AES options in the Dutch Rural Development Programme or a lack of time or expertise to identify and apply for suitable schemes on side of the farmers. The latter, however, is inconsistent with farmers perceived high level of knowledge about existing AES: five out of seven members indicated to be well informed about the AES offered. This presents the highest level of information of all clusters examined for this report. As the Dutch farmers' use of governmental or private advisory services is relatively low (three out of seven members, or 43 %, receive such advice), we can only hypothesise reasons for farmers' high expertise about existing AES. One potential explanation is the utilisation of extension services provided by the Flevoland AEC. This is supported by the observation from the literature that agri-environmental collectives have provided support for AES identification and application in the past (Franks & McGloin, 2007).

England – GWCT

The English cluster is the largest cluster both in terms of membership numbers and area covered. The group consists of 19 farmers with on average 444 ha of agricultural land. Accordingly, the habitats and farming systems found in the cluster are quite diverse. The landscape is primarily composed of combinable crops, with winter wheat covering the largest

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hectarage. Further, permanent grassland and short-term leys for grass seed production can be found in the cluster's area. Some farmers also hold small livestock numbers for beef, dairy or sheep farming. The cluster's environmental goals target farmland birds (particularly Corn Bunting, Lapwing, Grey Partridge, and Barn Owl), arable plants, pollinators and other beneficial insects, brown hare, harvest mice and hedgehogs.

As the English cluster was not part of the before-survey sample, no detailed data is available concerning the clusters' enrolment in AES or the level of farmers' knowledge about existing public schemes. However, the cluster lead and facilitator participated in the second survey and elaborated on which schemes are commonly applied in their group. The majority of cluster farmers is reported to wait for a new scheme, the Environmental Land Management Scheme, launching in 2024. This scheme is innovative, implementing both result-based payments and being open for group applications and thus incorporating a collective dimension in the scheme design (see section 5 for further details on these design options). In the meantime, the farmers are reported to extend their existing AES agreements issued under different AES including the current Countryside Stewardship Scheme and its predecessor. The existing AES agreements are primarily used to provide funding for establishing field margins, particularly grass margins but also pollen, nectar, and wildflower margins. Further, the cluster members receive funding for establishing extensively managed field corners and creating habitats for farmland birds. Finally, parts of the cluster area are dedicated to various grassland AES options, including the restoration of species-rich grassland, permanent low-input grassland, or improved grassland conditions.

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5. Innovative AES designs to support the Advanced Farmer Cluster approach

Traditionally, the vast majority of AES have been so-called action-based or management agreements that link payments to farmers to their adoption of pre-defined agri-environmental measures (Uthes & Matzdorf, 2013). This is also confirmed for the FRAMEwork clusters, as all AES documented to be used within the clusters are based on the prescription of management actions. Reasons for the predominance of action-based schemes are manifold. Amongst the most important, Burton and Schwarz (2013) list (a) their relatively high level of convenience in terms of implementation and monitoring effort, (b) high levels of acceptance by farmers as they present a secure source of income and often do not require radical changes to current practices, and (c) their compliance with WTO requirements. The latter note that AES eligibility shall "be dependent on the fulfilment of specific conditions (…) related to production methods or inputs" (*General Agreement on Tariffs and Trade 1994 - Final Act*, 1994, Annex 2, Art. 12). Further, payments "shall be limited to the extra costs or loss of income involved in complying with the government programme" (ibid.). Action-based schemes are thus predestined to meet WTO ruling by explicitly linking payments to production methods and inputs. They thereby provide assurance that no trade-distorting effects emerge from governmental programmes aiming for agri-environmental conservation.

The success of traditional action-based AES design has been a subject of debate in recent decades in light of moderate participation rates. Only approximately 25 % of the EU's utilised agricultural area is enrolled in AES (Science for Environment Policy, 2017). Moreover, the ability of action-based AES to reliably deliver substantial environmental outcomes on the ground has been questioned. In 2003, Kleijn and Sutherland (2003) contested the environmental impact of AES at that time. They found that only 54 % of the examined species had increased due to the introduction of a scheme and argued that many evaluation studies suffered from a poor design that biased them towards overly enthusiastic results. The more recent and extensive review by Uthes and Matzdorf (2013) confirms the notion of a "patchy success" (p. 256) of AES. The authors highlighted differences in scheme performance depending on the particular agri-environmental measure and result indicator in question. On the other hand, growing ecological evidence is pointed to some positive impacts of AES participation. For example, increases in species richness on organically farmed lands have been demonstrated (Batáry et al., 2011; Tuck et al., 2014) and positive outcomes from measures targeting farmland pollinators (Scheper et al., 2013). Batáry et al. (2015) collated these tentative positive results by means of a meta-analysis. The authors' results suggest particularly significant benefits from AES implementation generated outside of productive areas (*e.g.,* field boundaries and wildflower strips) compared to on-field measures such as fertiliser reduction. Finally, Kuhfuss et al. (2019) revisited the ecological evidence for AES success and concluded that "although examples can be found that demonstrate positive effects of specific AES options on individual target taxa, there is very little empirical evidence

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in the literature that AESs in general have any national scale benefit to farmland wildlife or ecosystem services" (p. 6).

The above examination of FRAMEwork cluster farmers' use of AES suggests further potential for improvement. First, this is indicated by low AES enrolment rates in some clusters (Italy, France) and a more or less apparent divergence of the reported group objectives and the actual AES implemented across the groups. For example, the schemes used in the Dutch cluster are exclusively centred around the promotion of bird habitat. No AES are utilised, however, to support other group goals such as soil health, pollinators, and natural pest regulation. And second, some dissatisfaction with overly restrictive or perceived inconsistent scheme requirements has been documented in the Czech and Luxembourgish clusters, calling for more flexibility in the way scheme objectives are delivered.

Finally, the piecemeal adoption of AES on the cluster level is striking. Usually only a portion of clusters farmers is enrolled in AES. The available schemes do not incentivise cluster or landscape level attainment of environmental results, but instead target the individual landholder or manager. In that regard, the available AES fail to promote the concerted implementation of conservation measures within FRAMEwork clusters and thus to enable landscape-scale management. The question arises if and how the predominant action-based design of public funding schemes can be adapted to align with the clusters' goal of collective conservation at a landscape level. Two promising design adoptions have sustained attention in agri-environmental research and policy-making in the last years and will be presented and considered in the following sub-sections. First, **payments may be conditioned on obtaining results rather than implementing actions** (*i.e.,* result-based AES). And second, **AES can be designed to target spatially concerted efforts of multiple farmers instead of isolated conservation by individual land managers** (*i.e.,* collective AES).

5.1. Result-based payments

As indicated above, result-based AES reward farmers not for implementing pre-defined management practices, but rather for the realisation of specified environmental outcomes without prescribing the means to deliver them (Burton & Schwarz, 2013). Experimentation with result-based approaches in European agri-environmental policy is no recent phenomenon but has been underway for some decades. Result-based payment programmes have been documented as early as 1993 using different terms such as "outcome-based/oriented", "result-oriented", "success-oriented", "objective-driven", and "performance payment" (Burton & Schwarz, 2013; Stolze et al., 2015). Many authors have since collected and reviewed the empirical evidence from piloting result-based AES (amongst others, Allen et al., 2014; Burton & Schwarz, 2013; Stolze et al., 2015; Zabel & Roe, 2009). To account for the steady increase of knowledge and experience across the EU, the Result Based Payments Network has been initiated in 2019 as a platform for exchange between

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researchers, policymakers and farmers working with result-based AES in Europe. The network has grown to over 130 experts since its foundation. Additionally, the European Commission has started to pave the way for result-based schemes to enter Member State's Rural Development Programmes by issuing a Result-based Payments for Biodiversity Guidance Handbook for the CAP period of 2014-2020 (Keenleyside et al., 2014).

5.1.1. Conceptual strengths and weaknesses

An extensive strand of literature has examined the merits and weaknesses of result-based payments relative to action-based rewards. Chaplin et al. (2021) identify four aspects from that literature that are frequently regarded as key strengths of result-based payments.

1. **Result-based payments promote lasting behavioural change** as the 'production' of environmental outcomes is incorporated into farmers' perception of farm management objectives. By valuing the delivery of environmental objectives in monetary terms, farmers are incentivised to consider them as outputs of their farming activities. Thus, previously conflicting management objectives (agricultural production and environmental conservation) may be aligned. This is suggested by an observed increase in farmers' interest in nature after participating in result-based schemes (Burton & Schwarz, 2013).
2. Result-based payments incorporate local knowledge and expertise in conservation efforts by allowing farmers to freely choose management activities. **They thus enable innovation, experimentation, and improved outcomes.**
3. Result-based AES simplify schemes by reducing the need to specify scheme options tailored to local conditions and circumstances. They thereby **lessen the informational requirements for the regulator as well as the administrative burden posed to farmers and authorities** (*e.g.,* no need to demonstrate compliance with multiple sub-measures or capital items).
4. **Result-based AES may increase the cost-effectiveness of the scheme**, as (i) payments are only made for results obtained, thus avoiding payment for non-delivery, (ii) farmers are incentivised to enrol their most suitable lands, thus preventing adverse selection, and (iii) farmers are encouraged to innovate to reduce their costs for scheme delivery, thus potentially enabling reduced overall payments to farmers where result-based schemes are offered repeatedly or over longer periods.

Cost-savings as in point 4 might also be generated if outcomes are more easily observable than inputs (Hanley & White, 2014; White & Hanley, 2016). However, this often depends on the specific scheme targets and outcome indicators in question. In fact, an adverse situation where monitoring outcomes (*e.g.,* counting birds) is costlier than observing management activities (*e.g.,* whether a wetland has been drained or not) is also imaginable (Reed et al., 2014, see also section 5.1.4). Opening the process of ecosystem service provision to learning

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and experimentation in result-based approaches (point 2) has increasingly led to the consideration of adaptive management principles in AES development and implementation. For example, the temporal extent of contracts has been increased to allow for learning processes to unfold (Burton & Schwarz, 2013). Furthermore, piloting schemes have adapted requirements and payments to account for the effects of external risks such as droughts (Ayambire & Pittman, 2021).

Risk

A one-sided consideration of the advantages of the result-based approach might give the impression that remunerating farmers based on outcomes presents a panacea. They (allegedly) increase farmers' utility by being less prescriptive and more responsive to farmers' preferences than action-based payments, but also offer enhanced cost-efficiency and ecological certainty to the regulator. However, **result-based payments come at a substantial cost, namely the additional risk of non-delivery that farmers face**. Ecological outcomes are commonly not just a function of farmers' actions, but also depend on factors outside of farmers' control (*e.g.,* climatic conditions, the behaviour of neighbouring farmers, diseases and pests, or natural oscillations of species' abundance). Result-based AES thus effectively shift the risk of not achieving the set environmental targets from the paying agency to the participating farmers, making farmers' remuneration at least to some degree dependent on such factors out of farmers' control (Burton & Schwarz, 2013; Reed et al., 2014). Consequently, governments need to cope with adverse effects of result-based schemes that might counterbalance some of the previously mentioned advantages. Perceived risk has been found to negatively affect farmers' willingness to participate in a result-based scheme (Dörschner & Musshoff, 2015; Massfeller et al., 2021). Furthermore, conceptual analysis (Derissen & Quaas, 2013) as well as experimental evidence (Tanaka et al., 2022) suggest that farmers are likely to require a 'risk premium' to compensate for their risk of not meeting the scheme requirements. Such a risk premium thus diminishes the potential gains in cost-efficiency. As farmers are frequently found to be rather risk-averse (e.g. Dörschner & Musshoff, 2015; Menapace et al., 2013; Reynaud & Couture, 2012), these unintentional effects might even be amplified. Researchers and practitioners have thus experimented with risk sharing and coping mechanisms that, for example, combine action-based and result-based approaches into hybrid schemes. These schemes offer a secure base payment that is topped with a bonus conditional on ecological outcomes (Derissen & Quaas, 2013; see also section 5.1.3). Additionally, more attention is given to the development of reliable performance indicators that ideally minimise the influence of external drivers on farmers' payment eligibility (see section 5.1.4) (Keenleyside et al., 2014).

Availability of indicators

The development of performance indicators poses an additional practical challenge of implementing result-based schemes. Performance indicators should ideally be (i) easily observable, (ii) representative of the ecosystem service or ecological outcome at hand, and

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(iii) influenced by farmers' management activities but preferably not by external factors. While sufficient indicators might be apparent for some applications, such as water quality measurements in catchment areas, more complex phenomena such as biodiversity enhancements are likely more challenging to capture with simple indicators. This issue of indicator development is considered more thoroughly in section 5.1.4.

Additionality

A further caveat of result-based payments is presented in terms of additionality, *i.e.,* their ecological impact compared to a (hypothetical) baseline without AES participation. The *goodness of fit* of agri-environmental measures (*i.e.,* the extra work or investment required to deliver scheme objectives) has been found to be an important determinant for farmers' willingness to enrol (Van Herzele et al., 2013). Thus, result-based payments that reward an absolute level of achievement instead of relative changes to an initial reference point are likely to attract farmers that would deliver the environmental outcomes irrespective of the existence of a payment (Bartkowski et al., 2021). However, the additionality of result-based payments can be enhanced by adapting the scheme design. This will be shown in the following sub-section. Lack of additionality is also an issue in action-based schemes (Vedel et al., 2015).

Farmers' capacity

By implementing result-based AES, governments transfer the responsibility for delivering scheme objectives from public agencies to farmers. The latter are thus not only coping with the additional risk of not achieving the set targets, but are also assumed to possess the knowledge, experience, and skill to identify and implement suitable measures. Given that environmental scientists themselves often indicate uncertainty concerning the complex dependencies linking management decisions with ecosystem dynamics (and *vice versa*), this assumption might be unreasonably optimistic (Moxey & White, 2014). This notion is supported by farmers' call for specialised training and education to deliver the required results, as indicated in some studies (*e.g.,* Šumrada et al., 2021; Wezel et al., 2018). The challenge is further amplified if farmers are expected to contribute to the considerable demand for monitoring and verification of outcomes via self-assessment (Chaplin et al., 2021; Keenleyside et al., 2014). For that reason, **providing specialised and adapted farm advice tailored to farmers' needs** to deliver scheme objectives is frequently understood to present one factor contributing to the success of result-based conservation programmes (Moran et al., 2021).

Costs

As Keenleyside et al. (2014) point out, cost increases likely occur due to farmers' additional efforts in ensuring that the targeted outcomes are obtained. These include (i) self-education and making use of advisory services, (ii) learning to use techniques for measuring outcomes and conducting monitoring trails, and (iii) collecting day to day ecological data (*e.g.,* related to weather, vegetation, grazing, …) to inform the decision-making process of which measures to implement. Furthermore, result-based payments might entail increased expenses for farmers in the short run, as innovation and associated efficiency gains require time. Thus, result-based AES might need to offer increased payments for farmers to motivate participation (Moxey & White, 2014). These objections are reflected in some farmers' views that result-based payments might be 'not worth it' because the associated costs for governments would be too high (Wezel et al., 2018).

Determination of payment amounts

A final practical challenge that influences the performance of result-based payments is linked to the calculation of compensation payments. Firstly, payments should reflect farmer efforts fully, including time spent on training or monitoring (Herzon et al., 2018). Setting adequate payment levels would thus need to, first, consider the heterogeneity of land systems that determine the complexity and quantity of measures needed to obtain the scheme targets. And second, farmers' diverse educational backgrounds and experiences need to be taken into account as determinant for the demand for extensional services. Furthermore, and perhaps more importantly, WTO regulations stipulate that compensation payments are based on the opportunity costs of compliance. Payments thus need to reflect the activities that farmers put into practice. Thereby, the need to base the level of payments on the expected average input of farmers erodes some of the advantages of the result-based approach, as it requires regulators to know which measures are most likely to deliver the targeted outcomes. Theoretically, it would be possible to bypass WTO regulations and reward farmers more directly for the delivery of ecosystem services (instead of mere compensation for income foregone). However, this would necessitate administering AES not as environmental payment schemes, but rather as general agricultural subsidies, which in turn are capped through the WTO's Aggregate Measurement of Support (AMS). Given that the EU does not max out the allowed quantity of subsidies included in the AMS, there is room for such a reassignment of AES payments as subsidies. However, to the best of our knowledge, this has not been practically implemented or considered up to now (Sidemo-Holm et al., 2018).

5.1.2. Empirical evidence on the performance of result-based AES

Table 1 provides an overview of real-world result-based programmes aggregated from the literature and complemented with input from FRAMEwork partners.[2]

[2] See the Cluster Lead Survey in Appendix A.3 for the questions related to the available AES in the clusters' countries.

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Table 1. Overview of result-based AES in Europe (Source: Allen et al., 2014; Burton & Schwarz, 2013; Stolze et al., 2015; Result-based Payments Network, FRAMEwork project partners)

Country	Programme	Type [a]	Land use type	Dates
Austria	Results-based nature conservation plan	Pure	Grassland and permanent meadows	2015-?
Austria	Humus-Programme of the Ökoregion Kaindorf	Pure	Humus-rich soils	2007-present
Belgium	Result-based payments for botanical grassland development in Beverhoutsveld	Hybrid	Grassland	2012-?
Finland	Golden Eagle conservation scheme	Pure	Grazing of reindeer	1998-present
France	Pastoral management plan (HERBE_09)	Hybrid	Mediterranean and mountain pastoral land	2007-?
France	Species rich grassland programme (HERBE_07)	Hybrid	Grassland	2007-?
Germany	Maintenance of species rich grassland through result-based agri-environment schemes according to national framework (*e.g.,* MEKA B4, PAULa, Nib AUM GL5/GN5)	Pure	Permanent Grassland	2000-present
Germany (Schleswig-Holstein)	Programme 'Blühendes Steinburg'	Pure	Permanent grassland	2007-?
Germany (Schleswig-Holstein, Bremen)	Grassland bird protection payments	Hybrid	Permanent grassland	SH: 1997-? Bremen: 2005-?
Germany (Nordrhein-Westfalen, Bayern)	Harrier nest protection in arable fields	Hybrid	Arable fields	1993-?
Germany	Measures targeting nitrogen emissions	Hybrid	Arable fields	n/d
Germany	Orchard schemes	Hybrid	Orchards and vineyards	Various
Ireland	Burren Farming for Conservation Program (BFCP)	Hybrid	Grassland	2004-?
Ireland	Irish Breeding Curlew EIP	Hybrid	Grassland	2018-?
Ireland	Protecting Farmland Pollinators	Pure	Farmland	2019-?
Ireland	Duhallow Farming for Blue Dot Catchments EIP	Hybrid	Farmland (catchment restoration)	2019-2023
Ireland	Blackstairs Farming Futures project	Hybrid	Upland grassland	2018-2022
Ireland	Hen Harrier Project	Hybrid	Upland grassland	2014-2019
Ireland	BRIDE project	Hybrid	Farmland (catchment restoration)	2018-2023
Ireland	Pearl Mussel Project	Hybrid	Farmland (catchment restoration)	2014-present

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Country	Programme	Type [a]	Land use type	Dates
Ireland & Spain	RBAPS project	Hybrid	Grassland and mediterranean upland	2015-2018
Italy	Landscape conservation	Hybrid	Grassland	n/d
Netherlands	Meadow birds – trial	Pure	Grassland	1993-1996
Netherlands	Meadow birds programme	Hybrid	Grassland	2000-2006
Netherlands	Meadow bird agreement with agri-environmental cooperatives	Pure	Grassland	2004-?
Netherlands	Species-rich grassland scheme	Hybrid	Grassland	2000-2006
Portugal	Payment for environmental results in the Portuguese Montado		Natural and semi-natural pasture, grassland	proposed
Spain	Management of firebreaks (RAPCA)	Pure	Shepherded grazing	2005-?
Spain	Mosaic Perennial Crops	Pure	Permanent crops	2015-2018
Sweden	Conservation performance payments (Lynx and Wolverine)	Pure	Grazing of reindeer	2000-?
Switzerland	Proof of Ecological Perfomance (PEP) and Biodiversity payments	Hybrid	Various	1998-present
Switzerland	Goal-oriented promotion of biodiversity in the Canton of Zurich	Hybrid	Various	2020-2026
United Kingdom (Scotland)	Species-Rich Grassland	Hybrid	Lowland grassland	n/d
United Kingdom (Scotland)	Piloting and Outcome Based Approach in Scotland (POBAS)	Various	Various	2019-?
United Kingdom (England)	Farm Conservation Scheme	Hybrid	Grassland	1993-1996
United Kingdom (England)	Countryside Stewardship (and the former Higher-Level Stewardship)	Hybrid	Arable land, permanent grassland, permanent crops	2014-present
United Kingdom (England)	RBPS for biodiversity on arable and upland grassland systems in England	Pure	Grassland	2016-2021
United Kingdom (England, Wales)	National Trust Payment for Outcomes Trial	Pure	Various	2019-2022
United Kingdom (England)	Environmental Land Management	Various	Various	Launching 2024

[a] Pure result-based AES: Entire payment is dependent on the obtainment of outcomes.
Hybrid result-based AES: Secure base payments (linked to prescribed management actions) is combined with a result-based bonus.

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Experimentation with result-based AES has been particularly wide-spread in Germany, the Netherlands, Ireland, and the UK. Interestingly, more than **50 % of the documented schemes are targeting grassland**. This trend has been recognised in the literature (*e.g.*, Herzon et al., 2018), though no explanation has been attempted so far. Literature on individual grassland schemes, such as the MEKA-B4 programme in Germany, suggests that the relatively low opportunity cost of implementing AES on grassland as well as the availability of botanical expertise for indicator development in governmental departments might have contributed to the predominance of result-based grassland schemes (Russi et al., 2016). Further, it is striking that two-thirds of the AES listed in Table 1 (13 out of 39) implement a hybrid design combining an action-based base payment with a result-based bonus. This observation will be discussed in section 5.1.3 on result-based design types.

Farmer acceptance

Farmers' acceptance of new result-based scheme designs is generally assessed *ex-ante* by applying stated-preference approaches such as Discrete Choice Experiments (DCEs) or survey questionnaires. In such DCEs, subjects (in the context of agri-environmental policy usually farmers) are faced serially with two or more mutually exclusive policy measures. Each measure is defined by a set of attributes which may take one or more levels. Subjects are then asked to select the preferred alternative or stick with the *status quo* (Hoyos, 2010). Through variation of the attribute levels offered in the choice sets, researchers can then statistically infer which attributes influence farmers' willingness to accept a particular policy measure. Further, results indicate the size of the effect of setting attributes to a particular level and help identify interactions between attributes.

The examination of farmers' eagerness to enrol in result-based policy schemes *via* DCEs is a rather recent trend in experimental research. To our knowledge, three DCEs have been published as of May 2022 and demonstrate ambiguous evidence. First, Tanaka et al. (2022) examine preferences for agri-environmental schemes of rice farmers in Japan. They found that farmers are generally inclined to participate in the proposed result-based scheme. However, the authors stress that the payment required to incentivise participation increases rapidly if more ambitious ecological objectives are set, indicating farmers' demand for exacerbating risk premia. Second, Šumrada et al. (2022) obtained similar results with farmers in Slovenia for a hypothetical scheme targeting dry grassland conservation. In their study, most farmers preferred result-based payments to an action-based approach. In contrast to these rather optimistic studies, Niskanen et al. (2021) found that a slight majority of Finnish farmers in their study perceives the current action-based approach as more acceptable. Indeed,a significant share of farmers in this study demanded high levels of compensation to motivate participation in a result-based AES. Interestingly, the authors found that the willingness to enrol in such AES (though with a relatively high requirement for compensation) is higher for younger farmers and those with relatively large farms. This aligns with observations made by Šumrada et al. (2022) that relatively older farmers with smaller holdings tend to choose the opt-out option as they prefer the *status-quo*. These findings suggest that (fixed) transaction costs might pose a higher burden to farmers with smaller holdings and that cultural differences related to a generation gap may play a role in respondents willingness to adopt policy change or experimentation with new approaches.

The acceptability of result-based schemes is confirmed by several qualitative studies examining farmers' responses to the introduction of a hypothetical scheme, including grassland conservation in Finland (Birge et al., 2017) and Slovenia (Šumrada et al., 2021), supporting weed-species richness in Germany (Massfeller et al., 2021), and schemes targeting mountain farming in the Alpines (Wezel et al., 2018). Finally, Birge and Herzon (2019) considered the cultural acceptability of the result-based approach for grassland biodiversity conservation to fit farmers' perception of 'good farming'-ideals. They find that the incorporation of nature's values through result-based remuneration aligns with farmers' notion of 'good farming'. Vainio et al. (2021) conducted a study on the perception of action- and result-based payments by surveying farmers and citizens in Finland. The authors concluded that farmers might perceive result-based payments as illegitimate. They link this to farmers' perceived necessity to reform the current agri-environmental policy. In other words, a switch to result-based payments is perceived legitimate if, and only if, the current agricultural policy is deemed not successful.

Overall, the existing research suggests that farmers' perception and acceptance of result-based schemes is mainly positive. However, the local context as well as farmer and farm characteristics do matter and particularly older farmers with small-scale farms might object to a result-oriented approach.

Empirical evidence on costs

The previous consideration of conceptual strengths and weaknesses has pointed to some concerns about the cost efficiency of result-based programmes. However, given the extensive numbers of result-based payment schemes piloting across Europe in the last decades (Table 1), is there any empirical evidence to confirm or reject said concerns? Despite the skyrocketing research around AES in the last years, explicit consideration of cost-efficiency of schemes is still scarce. In 2016, Ansell and colleagues found references to the costs of AES programmes in less than half of the considered studies and mentions of cost efficiency in fewer than 15 % (Ansell et al., 2016). As most prevalent AES programmes adopt an action-based remuneration mechanism, evidence about the cost-efficiency of result-based schemes is even more limited. Furthermore, the examination of result-based AES is often challenged in practice as outcomes cannot be easily distinguished from existing action-based programmes (Burton & Schwarz, 2013). Finally, McLoughlin et al. (2020) advocated caution if one attempts to compare budgetary requirements for existing action-based and result-based schemes. The authors argue that, in contrast to result-based payments, action-based AES do not necessarily deliver value for money (due to lack of monitoring). Besides, the piloting nature of most result-based programmes comes with substantial administrative costs that likely do not reflect the budgetary needs of an established nation-wide programme (ibid.). However, despite these concerns, the empirical evidence reviewed for this report indicates only moderate, if at all, additional costs of result-based programmes. Moran et al. (2021) report administrative costs of 15 % of the overall budget for the Irish Burren Programme as well as the Hen Harrier Programme and the Pearl Mussel project. Such administrative costs are comparable to action-based schemes (ibid.). In the case of the German MEKA-B4 programme targeting grassland conservation, experts from the administrative authorities as well as farmers assert transaction costs to be relatively low (Matzdorf & Lorenz, 2010; Russi et al., 2016). However, it has been noted that farmers in the MEKA programme usually did not need to change their already extensive management practices, thus minimising costs related to knowledge extension for farmers. Moreover, the experts responsible for indicator development were reported to be already familiar with the botanical characteristics of the regions in which the programme was rolled out (ibid.). Chaplin et al. (2021) indicate no substantial increase in costs for a result-based approach for the conservation of birds and pollinators in arable farming systems in England. In contrast, the authors observe improvements of environmental performance and thus suggest efficiency gains of the programme. On the other hand, Zabel and Roe (2009) document transaction costs of more than 50 % of a carnivore conservation programme in Sweden, indicating that monitoring costs for mobile species can be substantial. The potential of result-based remuneration thus likely depends on local circumstances (*e.g.,* farmers' and experts' capacity for monitoring) as well as the specific environmental objectives of the scheme (*e.g.,* mobility of target species).

5.1.3. Design types

While the discussion of strengths, weaknesses and performance of result-based payments usually assumes purely result-based designs *(i.e.,* all payments made are linked to outcomes obtained) these are rarely found in practice. Instead, many implemented result-based AES follow a hybrid approach in combining a fixed base payment linked to prescribed management activities with a bonus payment that is granted if ecological targets are achieved (Birge et al., 2017; Moran et al., 2021). This can present an intentional adaption of scheme design to account for farmers' risk preferences and reduce their objections against scheme enrolment (Gibbons et al., 2011; Wezel et al., 2018). It may also present an unintentional and often unrecognised side effect originating from the multitude of independent AES options available for farmers in their region (Burton & Schwarz, 2013). According to the latter argument, a result-based scheme might be initiated in a region that also offers farmers independent payments for actions, *e.g.,* the Swiss three-component payment tiers (Burton & Schwarz, 2013). However, in the Member States of the EU, this case does not apply given the EU's no-double-funding rule. Another application for hybrid schemes is presented in the case of outcomes which are difficult to measure, as is often the case for biodiversity indicators (Herzon et al., 2018).

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Our review confirmed the predominance of hybrid result- and action-based schemes as only one-third (13 out of 39) of the schemes listed in Table 1 implement pure result-based schemes. This trend towards hybrid schemes is acknowledged in the literature. For example, Burton and Schwarz (2013) identify schemes' disposition of rewarding either outcomes or actions more strongly as one of three key characteristics used to classify result-based programmes. This consideration (*i.e.*, which proportion of an overall payment should be linked to outcomes to maximise the delivery of scheme objectives) is increasingly made explicit in the literature. It is usually understood to be a function of farmers' risk preferences and the existence of information asymmetry between farmers and regulators (*e.g.*, Derissen & Quaas, 2013, see also section 5.1.5). Finally, hybrid schemes need also to be evaluated in terms of their administrative efforts for farmers and authorities, as monitoring both inputs and verifying results might entail considerable budgetary limitations (Chaplin et al., 2021).

Payments by modelled results

An alternative design approach that entered the discussion in recent years is payments by modelled results. Instead of monitoring outcomes and setting payment levels ex-post (*i.e.*, after management activities have been implemented by the farmers), the core idea of a modelled-results scheme is to remunerate farmers based on the predicted outcomes of management decisions. These predicted outcomes are estimated by spatially explicit biophysical models (Bartkowski et al., 2021). Using models to refine the performance of AES has been proposed as early as 2014. At that juncture, this was understood as a means to target regions and activities with action-based scheme options that are most likely to deliver ecosystem service benefits (Reed et al., 2014). Against this objective, Reed et al. (2014) proposed to use pressure-response functions to depict the linkages of management activities, external pressures, ecosystem functions and services for peatland management. This proposal was put into practice in a pilot for managing the run-off of agricultural nutrient flows into Lake Erie, USA, within the context of a reverse conservation auction setting (Palm-Forster et al., 2016). In two Ohio counties, farmers were invited to specify management practices, farm characteristics and their required compensation payments to adopt practices that are expected to hold back or reduce nutrient run-off from their lands. Applications were then scored based on the predictions of a watershed model and the most promising bids were offered 1- or 2-year contracts to implement the suggested practices (Palm-Forster et al., 2016). These studies used modelling in an attempt to improve either the quality of measures that are offered to farmers in action-based schemes or to help identify regions where identical measures offer enhanced outcomes. A more stringent model-based approach is proposed by Bartkowski et al. (2021). The authors suggest a 5-step procedure for basing payments in AES on model predictions. It includes (i) data input, (ii) predicting environmental outcomes of combinations of potential management measures, (iii) calculating payment levels that reflect those outcomes, and (iv) letting farmers choose management activities or combinations (and related payments) that suit their preferences and skills. Payments by modelled results are thus understood to combine the strengths of both action- and result-oriented schemes: they maintain the payment certainty of traditional action-based schemes for farmers while offering an enhanced outcome certainty (compared to action-based AES) to the regulator (Bartkowski et al., 2021; Sidemo-Holm et al., 2018).

AES by modelled results face considerable challenges that might limit their applicability as a broad-scale policy instrument. The performance of a modelled result-based scheme hinges on the accuracy of model predictions. The development of a model that sufficiently covers the complexity of interconnected human-environment systems requires substantial resources that might easily exceed the budgetary constraints allocated to most rural developments programmes. This is amplified by the fact that the required expertise for model development is usually not located in the governmental administrations responsible for rural development. The access of external (and thus costly) expertise is thus likely required, further straining the programme budget. Furthermore, given the complexity and diversity of ecosystem dynamics underpinning the delivery of ecosystem services, any single model will likely only map the socio-ecological dynamics related to one (or a small set of related) ecosystem services. Finally, the development, parameterisation and verification of any model requires extensive data. This data that would need to be spatially explicit on the farm scale (to calculate the outcomes from activities at that scale) and also include information about the management practices applied prior to AES enrolment (Palm-Forster et al., 2016). Hence, modelled results would by no means replace the need to monitor ecological data and might even pose additional informational requirements on the participating farmers. Thus, more research is needed to explore the applicability of model-based schemes for different contexts and environmental objectives. Modelled results might present a promising alternative where measuring outcomes on an appropriate scale is not feasible (*e.g., s*oil functions), while traditional action-based or result-based measures might be more promising in other areas.

5.1.4. Result indicators

At the core of realising the success of result-based incentive schemes is the availability of suitable indicators that reflect farmers' performance while being reasonably easy to implement for regulators. The development of such indicators is frequently cited as an important ingredient of successful result-based AES (*e.g,.* Keenleyside et al., 2014; Moran et al., 2021). Herzon et al. (2018) even regard this as a necessary pre-condition to justify the consideration of result-based payments in the first place. The significance ascribed to indicator development is further confirmed empirically as it is frequently mentioned as one of the main scheme attributes that determine farmers' willingness to participate in a result-based programme (Matzdorf & Lorenz, 2010). Hence, a lot of research has been invested in the design of indicators for various farming systems and habitat types that target diverse environmental objectives (*e.g.,* Kaiser et al., 2019; Matzdorf et al., 2008; Wittig et al., 2006). Furthermore, the EU has issued a collation of biodiversity indicators for different habitats and species (*e.g.,* grassland, orchards, arable weeds, large predators) in an attempt to collect best practices for policymakers about indicator development and testing, measurement and verification (Underwood, 2014). Keenleyside et al. (2014) and Burton and Schwarz (2013) review the literature on performance indicators and find that well-chosen indicators meet a range of different criteria:

- be representative of the ecological goals of the scheme;
- occur consistently in target farmland habitats in the area;
- be easily identified by farmers or paying agency representatives;
- be measurable using a simple methodology;
- be sensitive to changes in agricultural management but otherwise stable;
- be unlikely to be influenced by external factors beyond the control of the land manager;
- not be achieved easily by means other than agricultural management; and
- should not conflict with agricultural goals.

Suitable indicators and measuring protocols thus ideally fulfil a range of requirements. Not all such requirements are likely to be met in the context of a particular scheme, and trade-offs between criteria might occur. Nevertheless, empirical evidence suggests that it is possible to design indicators that enable both the reliable evaluation of farmers' conservation efforts and are well-accepted by the participating farmers (Birge et al., 2017; Russi et al., 2016).

Distorted measures

Particular attention has been paid to what Zabel and Roe (2009) call 'distorted measures', *i.e.,* indicators that reflect activities of scheme participants that are not, or only weakly, correlated with the environmental target. Distorted measures fail to entirely reflect farmers' efforts and thus do not account for the conservation success obtained. In the extreme case, distorted measures can even lead to adverse incentives. Zabel and Roe (ibid.) provide an example of Kenyan fishers who were rewarded for releasing turtles from fishing nets, thus effectively providing an incentive to intentionally fish for turtles to maximise scheme payments. Distorted measures do thus represent a (potential) drawback of traditional input-based programmes (rewarding for realising action A based on the assumption that this will lead to outcome B). They can be tackled by appropriate choice of indicators in result-based AES.

Coping with risk

As indicated before, a major hindrance for farmers to participate in a result-based scheme might be posed by the risk of not achieving the stipulated outcomes. As explained above, this risk is not only linked to uncertainty on the farmers side regarding the identification and implementation of suitable measures to obtain results (*e.g.,* due to lack of knowledge). Rather, risk is also generated through external factors outside of farmers' control, such as extreme weather events or pest infestations. A potential means to tackle the latter has been touched upon in the previous section, namely combining result-based bonuses with secure

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action-based base payments. Another potential solution includes measuring the participants' achievement of outcomes not in absolute terms but in relation to other farmers enrolled in the same scheme. This approach is termed *relative performance evaluation* (Zabel & Roe, 2009). Relative performance evaluation assumes that "several participants face production noise that is correlated" (Zabel & Roe, 2009, p. 131), *i.e.,* all farmers in an area are similarly influenced by the external conditions. The scheme would then evaluate farmers' outcomes relative to each other. The assumption of correlated production noise likely holds for some external drivers like weather conditions if the farms are spatially close. However, other external events such as pest infestations presumably only impact a sub-group of participating farmers, putting them at risk of not receiving scheme payments. Furthermore, such a scheme design might give rise to collusion when farmers collectively decide to deliver low performance (Zabel & Roe, 2009).

Additionality

Many existing result-based programmes base payments on absolute performance criteria irrespective of the status of the land at the time of enrolment (*e.g.,* MEKA in Germany). As already mentioned, this raises issues of additionality, as farmers are likely to participate who reach the environmental target without changing their current management practices (Engel, 2016). The overall impact of the scheme can then be questioned. One might argue that preserving those sites by preventing farmers from adopting more intensive farming practices (or land abandonment) already delivers value for money. However, some programmes aim to ensure additionality by measuring environmental outcomes not in absolute terms at the end of a programme, but the relative change compared to an initial baseline. This reference point is usually set at the time of entering into the scheme. An example programme for such relative performance measurement is the Humus Programme of the Ökoregion Kaindorf in Austria. The programme rewards farmers for the accumulation of humus in their soils relative to a soil sample at the start of the contract.[3] While being unequivocally successful in rewarding only positive changes of the ecological status, this scheme design comes with additional administrative efforts linked to the monitoring of not only environmental outcomes but also starting conditions. Furthermore, there is a risk that farmers intentionally deteriorate land conditions prior to joining the scheme to maximise payments (Engel, 2016).

Number of indicators

Another design consideration related to the measurement of farmers' performance is whether one single indicator or several indicators are required. Naturally, keeping the number of indicators as low as possible provides not only cost savings to the paying organisation, but is also beneficial in reducing the complexity and administrative effort of implementing (and complying with) the scheme. However, two situations might occur that require or suggest the use of multiple performance measures. First, it might not be possible

[3] Case study description available on https://www.areflh.org/en/euprojects-ok/console-case-study-on-increasing-the-humus-in-soils (accessed May 18, 2022).

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to cover inherent characteristics of the environmental goal with only one indicator. This is usually the case where biodiversity increases are set as an objective. This case poses the challenge of determining a number of indicator species that is representative of the biodiversity status of the habitat, while avoiding extensive monitoring costs by including too many species (Burton & Schwarz, 2013). Second, it can be advisable to consider several performance indicators to deal with external risks (*e.g.,* weather) or distorted measures. For example, consider a case where no ideal indicator for the environmental target at hand exists. One might start with an outcome indicator that is highly representative of the environmental target but also influenced by factors outside of farmers' control. This indicator may then be complemented with a second measure that is less risky but also less accurate in its representation of the ecological good in question (Zabel & Roe, 2009). The interested reader is referred to Zabel and Roe (2009) for suggestions on how several performance criteria can be weighted to form one integrated performance measure.

Sensitivity of payment levels

Finally, the incentive set through result-based payments is determined by the sensitivity of payment levels to the production of an environmental good (Burton & Schwarz, 2013). A regulator might set a single environmental threshold to be reached to be eligible for compensation (as is the case for the former MEKA-B4 programme in Germany[4]). While single performance thresholds entail a relatively low administrative burden, concerns have been raised that they might have adverse effects if the ecological status of participating farmers' lands is rather heterogeneous. For example, a single indicator for species-rich grassland might allow the deterioration of high-quality habitats without losing money, while still being too environmentally ambitious to induce conservation efforts of managers of poorly preserved grassland (Keenleyside et al., 2014). A solution to this problem is presented by using multiple, stepped thresholds to incentivise farmers more broadly. Alternatively, linear payments can be applied that directly link payment amounts with the quantity of the environmental good (*e.g.,* the number of nesting birds) (ibid.). The former has been introduced as an additional incentive in the MEKA-B4 successor FAKT-B3 in Germany. The FAKT-B3 scheme now includes two thresholds (linked to the demonstration of the existence of four or six indicator plant species) to reward the conservation of species-rich grassland (Russi et al., 2016). Further, the 'species-rich grassland' scheme in Lower Saxony, Germany, (AUM GL5) features three thresholds linked to stepped *per*-hectare payments.

Self-monitoring by farmers

When it comes to monitoring outcome indicators on the ground, a common approach within result-based AES is to involve farmers via self-assessment. This is seen as bringing a range of

[4] The MEKA-B4 program, 2007-2014, lists 28 indicator plant species of wildflowers that typically can be found on dry, humid, wet and mountainous meadows in south-western Germany. Farmers receive an annual payment if they can demonstrate the existence of four indicator species on appr. one-third of their land area (Russi et al., 2016).

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advantages, including (i) the provision of 'real-time' feedback to farmers and thus helping them fine-tune their management decisions, (ii) promoting farmers' understanding of the agro-ecological dynamics on their lands and facilitating the incorporation of nature values into their perception of farm business, (iii) increasing farmers' sense of ownership over the ecological results and (iv) offering a reduction of the expenses for monitoring by external experts (Chaplin et al., 2021; Keenleyside et al., 2014). However, self-monitoring by farmers requires the input of substantial amounts of their time (and an associated monetary compensation (Tanaka et al., 2022)), knowledge and skills (Chaplin et al., 2021). Moreover, self-monitoring potentially incentivises farmers to document exaggerated outcomes to obtain higher premia (ibid.). This can be addressed by complementing self-monitoring with random checks by external authorities. Overall, existing result-based AES using farmer self-assessment generally report positive results (*e.g.,* Chaplin et al., 2021; Klimek et al., 2008; van Dijk et al., 2015; Wittig et al., 2006), but stress the importance of extensive advice and farmer training as a prerequisite for success.

5.1.5. Applicability of a result-based approach

Having discussed the merits of basing payments to farmers on the ecological outcomes obtained, the question arises whether policymakers should aim to implement result-based payments whenever possible. The previous considerations have already pointed to settings where a traditional action-based remuneration might be more advisable, *e.g.*, if no suitable indicator(s) can be identified to measure scheme outcomes at reasonable costs (Birge & Herzon, 2019; Keenleyside et al., 2014; Zabel & Roe, 2009). Other concerns raised in the literature that favour the adoption of payment-by-actions include (i) a lacking capacity on the regulator's side to develop and run a result-based scheme (*e.g.,* due to limited expertise available for indicator development) or (ii) farmers' unwillingness to accept a result-based payment approach (Herzon et al., 2018; Keenleyside et al., 2014). Furthermore, attention must be paid to farmers' experiences and skills concerning the management practices that are expected to be required for achieving a set outcome. Farmers might be unable to cope with a need for considerable ecological improvement and innovation, especially within the limited temporal scope of traditional AES (*i.e.,* up to five years) (Šumrada et al., 2022; Uthes & Matzdorf, 2013). In contrast, conditions that predestine the use of result-based incentives are said to include contexts where the management actions expected to deliver the ecological objectives are hidden and thus hard to observe for the regulator (Hanley & White, 2014). Result-based AES might also be favourable if the environmental target is relatively insensitive to management actions, thus challenging the predefinition of required conservation efforts, particularly in case of heterogeneous land systems (Gibbons et al., 2011).

On a more conceptual level, computational models have been applied to examine conditions that favour the implementation of result-based or action-based payments. These studies

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indicate that a purely result-based remuneration is optimal only if no environmental uncertainty exists (*i.e.,* the linkage between management actions and environmental outcomes is certain and known by farmers) and both farmers and the regulator are risk-neutral (Derissen & Quaas, 2013). On the other hand, payments that are exclusively linked to management actions are optimal only in the absence of information asymmetry, *i.e.,* when the regulator has perfect knowledge about the productivity of management efforts (Derissen & Quaas, 2013; Gibbons et al., 2011; White & Hanley, 2016). Neither condition will likely be met in real-world circumstances, which commonly include unforeseeable risks of not reaching an environmental target, decisions made by risk-averse farmers, and imperfect knowledge of the responsible authorities concerning the environmental impact of management choices. Therefore, a combination of action-based and result-based measures is deemed most beneficial from a theoretical standpoint (Derissen & Quaas, 2013). Hence, these findings offer justification for the widespread adoption of hybrid scheme designs as found in subsection 5.1.2.

Finally, Moxey and White (2014) articulate strong objections against hastily turning away from action-based schemes. They bring forward the argument that result-based payments neither address all the weaknesses of action-based AES, nor that a shift to result-based remuneration is always necessary to address these. For example, the authors point to the possibility to improve the cost-efficiency of action-based schemes by employing spatial targeting and payment differentiation. Further, management prescriptions of action-based schemes may be relaxed to allow for innovation and the inclusion of local expertise without putting the responsibility for result-obtainment solely in the hands of farmers (ibid.). Overall, Moxey and White (*ibid.*) argue to acknowledge and make use of the advantages of the result-based payment approach, while not losing sight of the role of the broader institutional framework in determining the outcomes of any monetary incentive programme. This is confirmed empirically in a case study targeting the conservation of High Natural Value grassland in Slovenia (Šumrada et al., 2021). The study demonstrates that the switch to result-based remuneration does not address many of the present institutional challenges such as supporting small and subsistence farmers or inducing conservation in areas with highly fragmented land ownership (*ibid.*). Overall, one should keep in mind that the consideration of result- *vs*. action-based payments is just one of many design features of AES (Engel, 2016). Thus, switching from an action-based design to result-based payments is unlikely to solve all issues with AES. Rather, a holistic approach that considers AES design and agro-ecological and economic contexts in its entirety is required.

5.2. Collective schemes

A call to incorporate a collective dimension into the design of AES has been prompted by the recognition of a scale mismatch between AES and ecosystem service dynamics. While

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conventional AES usually target the spatial scale of individual farms, the ecological dynamics underpinning ecosystem service provision are understood to operate at far greater spatial scales (Cumming et al., 2006; Emery & Franks, 2012). Scale mismatches are found to emerge frequently in the management of complex social-ecological-systems (Cumming et al., 2006). They are often attributed to detrimental effects on ecosystem management ranging from the occurrence of inefficiencies and reduced resilience up to management failure (*ibid.*). Scale mismatches thus offer a potential explanation for the mixed results obtained from AES in the past decades. Empirical data confirms this concern. For example, McKenzie et al. (2013) demonstrate that one-third of the taxa important for English farmlands including bird, mammal, reptile, amphibian, and bumblebee species require habitats that exceed the average English farm size. Additionally, the accumulation of organic farms in an area has been found to increase biodiversity beyond the level achieved on isolated farms, pointing to additional benefits generated by landscape-scale agri-environmental efforts (Sutherland et al., 2012). Given that scale mismatches of ecosystem service provision on agricultural lands are primarily created through the fragmentation of land ownership, an institutional framework is required that incentivises concerted actions of adjacent land managers. In the European Union, such incentives could potentially be provided via the Common Agricultural Policy (CAP) and the agricultural payment programmes issued under Pillar 1 and Pillar 2. However, the CAP has been criticised in the past for failing to address fragmented land ownership (Leventon et al., 2017). The CAP has been even argued to amplify adverse effects through payment programmes that explicitly target individual farms, and by promoting conditions that hamper the collaboration of multiple farmers (*ibid.*). The matter of incorporating a collective dimension into agri-environmental policy is now increasingly being considered in the literature (for example, see Franks (2019) for an examination of the English case). This is following the recognition that many valuable ecosystem services (such as pollination, pest control, flood control, and water purification) are well suited for collective management by farmers (Stallman, 2011).

In contrast to result-based approaches, real-world applications of collective incentives are as yet scarce (Table 2). Existing evidence is mostly generated through theoretical and experimental research. Incentivising concerted efforts of multiple farmers or the achievement of defined spatial patterns of enrolment (*e.g.,* for habitat corridors) can be achieved by multiple means. The following review will focus on the four most frequently discussed design options: (i) collective contracts and/or payments, (ii) conducting conservation auctions that allow for joint bids of farmers, (iii) issuing agglomeration or threshold bonuses that reward spatial agglomeration additionally to an independent base payment, and (iv) issuing agglomeration or threshold payments that are entirely conditional on the achievement of spatial objectives.

The programmes listed in Table 2 will be exemplarily presented in the respective subsections below. It is striking that the majority of programmes (*i.e.,* seven out of 12) implements bonus payments (*i.e.,* agglomeration or threshold bonuses). This might be linked to their expected high acceptability to farmers, given that they present relatively low barriers for enrolment (*e.g.,* low conditionality on spatial outcomes). Agglomeration and threshold bonuses might thus be perceived as particularly well suited for first experimentation with collective AES, before turning to more advanced and strict designs. The small number of schemes in Table 2 challenges the identification of any more general patterns. However, it may be said that collective AES are documented from around the globe (*i.e.,* Australia, Europe, South and North America, Asia, Africa) and covering a range of different land use systems (*e.g.,* arable land, grassland, forests, water catchments).

Table 2. Global overview of collective AES programmes (Source: aggregated from Berthet et al., 2021; Narloch et al., 2017; Nguyen et al., 2022; Zabel & Roe, 2009)

Country	Programme	Type	Land use type	Temporal scope
Bolivia Peru	Payments for Agrobiodiversity Conservation Services (PACS)	Collective contract	Arable crops: Quinoa landrace varieties	2010-2011
France	Conservation of European Hamster habitats in Alsac, France	Collective contract & Threshold payments	Arable land	2013-?
Netherlands	All AES are only open for application from agri-environmental cooperatives	Collective contract	Various	2016-present
Sweden	Conservation performance payments (Lynx and Wolverine)	Collective contract	Grazing of reindeer	2000-?
Australia	Auction in the Desert Uplands of Queensland	Auction with threshold bonus	Grassland with beef grazing	2006-2008
England	Environmental Stewardship scheme (ESS-HR8)	Agglomeration Bonus	High Nature Value areas	2005-present
Malawi	Smart Subsidies for Catchment Conservation	Agglomeration Bonus	Arable land	n/d
Switzerland	Swiss Network Bonus	Agglomeration Bonus	Various	2001-present
Australia	Dryland salinity credit trade scheme	Threshold Bonus	Dryland river and lake catchments	2005-?
Mexico	Payments for Hydrological Services	Threshold bonus	Forests	2003-?

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United States	Conservation Reserve Enhancement Program in Oregon (CREP)	Threshold Bonus	Buffer strips along streams	1998-present
Japan	Kuma Joint Management Programme (KJMP)	Threshold Payments	n/d	2006-?

5.2.1 Collective contracts

A straightforward approach to ensure the concerted uptake of agri-environmental measures is to open schemes exclusively or optionally for applications of groups of spatially close farmers. Besides the simultaneous and coordinated implementation of scheme objectives, collective contracts are said to deliver cost savings by reducing both public and private transaction costs. Public transaction costs are saved by reducing the number of actors involved in contracting, monitoring and verification or by delegating tasks such as information collection to the contracted intermediary (Franks, 2011; Narloch et al., 2017). Private cost-savings may be delivered through the exchange of expertise and lessons learned within farmer groups, thus reducing the need for external and expensive farm advisory services (Franks, 2011). Furthermore, collective contracts can work as a joint-liability mechanism, promoting scheme compliance of the whole group by internally reallocating required tasks if individual members are unable to meet the scheme requirements (Narloch et al., 2017).

Collective conditionality

Collective contracts implement collective conditionality, *i.e.,* payments made in such programmes are conditional on the collective performance of the contracted group. Various experimental studies investigate subjects' reaction to such an approach. For example, LeCoent et al. (2020) conduct a threshold public good game to examine the effect of collective conditionality on conservation outcomes. The authors compared a collective threshold for receiving payments with an unconditional individual payment proportional to individual efforts. Their results indicate that collective conditionality might be more effective than individual conditionality. However, the authors stressed that coordination success in their experiment was frequently determined by other factors such as successful cooperation in the past and risk-aversion. Their results thus point to path-dependencies in participants' decision-making and the need for skilful facilitation to ensure cooperation from the beginning. Experimental evidence by Villanueva et al. (2015) further suggest an influence of socio-demographic and cultural factors on farmers' willingness to accept collective conditionality. The authors utilise a choice experiment to examine farmers' willingness to collectively enrol in a hypothetical AES in southern Spain. They find a strong heterogeneity in farmers' perception of transaction costs and disutility resulting from collective participation in the scheme.

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Differentiated payments

As the eligibility to receive payments in collective contracts is dependent on the collective performance of the group, the question arises whether payment levels should then reflect individual or collective efforts. From an administrative point of view, undifferentiated payments (*i.e.,* all members receive an equal share of the total payment) are clearly advantageous. This is linked to the lower administrative effort of issuing equal payment amounts due to the lower demand for information on individual efforts, costs, and benefits. However, undifferentiated payments might be expected to result in collective action problems as an individual farmer is incentivised to free-ride on the collective efforts. The experimental evidence confirms a mixed performance of undifferentiated payments. In the Andean mountains region, Midler et al. (2015) conducted a framed field experiment with Peruvian farmers examining the effectiveness of differentiated *vs.* undifferentiated rewards (*i.e.,* proportional to individual *vs.* collective contributions to the environmental target). They found that undifferentiated collective rewards might be perceived as unfair by farmers. Further, communication proved to be crucial in their experiment to ensure conservation success in the case of undifferentiated payments. The authors concluded that differentiated individual rewards (*i.e.,* conditional on the collective achievement of a conservation outcome but reflecting the individual farmer's effort) might be the most cost-effective. The risk of free-riding undermining the effectiveness of collective, undifferentiated payments is further demonstrated in a framed field experiment in the context of forest conservation in Tanzania. In this experiment, the introduction of an undifferentiated group reward did not achieve significant increases in contributions compared to a no-policy control group (Kaczan et al., 2019). Narloch et al. (2012) also found that collective-level payments that are less strongly linked to individual efforts do not trigger higher contributions to an environmental good. The authors conducted a framed field experiment in the context of quinoa cultivation with farming communities from the Bolivian and Peruvian Andes. Finally, Bouma et al. (2018) offer a more nuanced examination of payment differentiation by comparing differentiated and undifferentiated payments both with standard student subjects (lab experiment) and farm management students (lab-in-the-field experiment). The authors found that differentiated payments were more effective in the lab but did not improve outcomes in the lab-in-the-field. Overall, evidence suggests that differentiated payments might better align with farmers' fairness preferences and thus trigger higher individual conservation efforts. This potentially challenges public authorities which have to weigh improved conservation outcomes through issuing differentiated payment with their higher transaction costs. A potential solution to this trade-off is presented in the form of group payments.

Group payments

A further design choice of group-based contracts relates to whether one (large) payment is made to the whole group (hereinafter referred to as 'group payment') or farmers receive their payment individually (hereinafter referred to as 'individual payment'). Group payments can help to overcome information asymmetry between regulators and farmers. By issuing payments directly to groups, these can utilise their greater knowledge about farming systems and land characteristics within the group to allocate differentiated payments that reflect farmers' actual opportunity costs. Group payments can thus help to avoid over- or undercompensating individual farmers as in uniform payments. Further, letting the group decide internally how payments are distributed can be expected to disincentivise free-riding behaviour. Farmers may thus be prevented from withholding their contribution to their group's environmental goal if overall conservation efforts are high. Narloch et al. (2017) additionally demonstrated by means of two piloting AES in the Bolivian and Peruvian Andes that group payments can mitigate rent-seeking in the context of reverse conservation auctions. The authors further emphasise that group payments are likely particularly beneficial in contexts where collective action approaches are already well established. It has to be noted that group payments may take various forms including investments into collective resources (*e.g.,* community infrastructure), payments made to individual group members or a mixture of both (Zabel et al., 2014). In the context of a result-based AES for carnivore conservation in Sweden, empirical evidence suggests that payments made directly to group members (as opposed to public investments) are more successful in promoting conservation efforts (*ibid.*). On a conceptual note, Engel (2016) points to the risk of elite capture if payments are distributed internally and power asymmetries exist. Following this argument, farmers' trust in the legitimacy of internal distribution mechanisms is a prerequisite for successful and efficient group payments (*ibid.*).

Experimental evidence on the effect of endogenous rule-making is mixed. Some studies suggest positive effects from introducing endogeneity in the context of public good games (Gallier et al., 2017; Haigner & Wakolbinger, 2010) and prisoners' dilemma games (Bó et al., 2010). However, letting subjects decide endogenously on the payment distribution rule in a threshold public good game by Bouma et al. (2018) did not significantly impact group performance. Further research is needed to investigate farmers' preferences for group payments, particularly in a cluster context. This would help to determine whether FRAMEwork clusters would benefit from payments issued to the cluster as a whole.

Agri-Environmental Collectives in the Netherlands

A step towards collective contracting has been made on a broad scale in the Netherlands by administering AES agreements *via* so-called Agri-Environmental Collectives (AECs). In 2016, the Netherlands switched to collective enrolment for the Dutch Agricultural Nature and Landscape Management scheme and nullified individual contracting in national AES. Instead, the Dutch Ministry of Agriculture initiated the formation of 40 agricultural collectives, the AECs, which are contracted at the national level to conclude contracts with individual farmer members (Boonstra et al., 2021). Furthermore, the Dutch government granted provinces and the AECs more flexibility over AES administration and implementation, trying to enable locally adapted solutions for nature and landscape management (Boonstra et al., 2021). With membership numbers ranging from around 100 to more than 1,300 farmers (Boonstra et al.,

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2021, p. 24), AECs comprise more members than the UK or FRAMEwork farmer clusters. Large membership sizes question their ability to offer distinct benefits to individual farmer members. First, knowledge exchange and effective collective action is challenged by group size (Yang et al., 2013). Second, other benefits such as risk-sharing are not exploited by sticking to 1-to-1 contractual designs (Boonstra et al., 2021). Hence, Dutch AECs appear to primarily present a means to formally organise more decentralised and concerted cross-farm agri-environmental management without explicitly promoting farmer-farmer collaboration or learning processes. This concern has also been voiced in the literature. Westerink et al. (2020) examined the duplex role of AECs as (historically) self-governing farmer groups that now adopt functions from public agencies by formally administrating AES contracts. The authors concluded that their twofold role results in an identity conflict of Dutch AECs, challenging their ability to foster bonding social capital between farmers and thus enable effective landscape management. Nevertheless, interim results of a formal evaluation of the Dutch case point to positive effects of the AEC approach in terms of implementation costs and landscape-scale coordination of AES enrolment (Boonstra et al., 2021; van Dijk et al., 2015; Westerink et al., 2017).

Overall, it appears that collective contracts can in principle be a suitable tool for ensuring concerted management actions of multiple farmers. They may also offer other benefits such as a lessening of the administrative burden posed by the regulating authorities or a chance for farmers to share the risk of scheme participation with their group. However, farmers might be reluctant to join a collective contract, as it conditions payments on the behaviour of others. Differentiated payments may be applied to minimise the incentive for free-riding. Furthermore, group payments may be utilised to cost-efficiently access information on individual efforts, costs, and benefits. However, issuing payments to the whole group might also give rise to payment mechanisms that are perceived as unfair. Thus, the democratic legitimacy of endogenously decided distribution rules is crucial to ensure that farmers approve of and trust in internal payment allocation.

5.2.2 Collective incentives in conservation auctions

Conservation auctions represent a frequently utilised tool to allocate compensation payments to ecosystem service providers. They work as competitive tenders in which eligible landholders or managers compete to receive a limited amount of contracts offering compensation for implementing conservation actions on their lands (Schilizzi, 2017). Due to the competitive nature of an auction, farmers are incentivised to bid close to their actual opportunity costs. They thereby enable cost savings for the ecosystem service buyer (usually governments) by aligning scheme payments with the actual costs for ecosystem service provision (Uthes & Matzdorf, 2013). Detailed information on farmers' heterogenous opportunity costs is often not available for the public agency acting as ecosystem service

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buyer (Ferraro, 2008). Conservation auctions thus present a mean to address information asymmetry and reduce informational rents (*ibid.*). Consequently, they enable cost-effective allocation of limited budgets. The first conservation auction has been implemented in the USA in 1985 (the Conservation Reserve Program, CRP). Extensive research has since focused on the workings, dynamics, and outcomes of conservation auctions.[5] Known challenges in conducting conservation auctions include farmers colluding on the payment levels requested in their submitted bids. Furthermore, farmers whose bids were not accepted for funding have occasionally been reported to develop protest attitudes and turn to detrimental farming practices (Uthes & Matzdorf, 2013). Finally, traditional auction design is usually not successful in ensuring the achievement of defined spatial patterns of scheme uptake, thus requiring additional measures if landscape-scale connectivity is needed. Two design supplements are available for that objective: (i) considering spatial metrics in the scoring process of submitted bids (spatially weighted auctions), and (ii) allowing for joint bids of multiple, spatially close farmers (Kuhfuss et al., 2019).

Iftekhar and Tisdell (2016) show by means of an agent-based simulation model targeting the conservation of habitat corridors that both options come with higher procurement costs compared to non-spatial bid selection. This is mainly attributed to the need to procure the enrolment of relatively expensive land parcels that are important for obtaining the desired spatial pattern. The authors highlight the potential of utilising offsite synergies in an auction setting. These offsite synergies are positive spill-over effects, *i.e.,* conservation actions by one actor enable cost-savings also on surrounding land. Farmers then may incorporate their expected cost savings due to offsite synergies in their joint bid offers. This is particularly important to counterbalance the lower competition in a collective format resulting from the lower number of bids compared to individual tenders. The findings by Iftekhar and Tisdell (2016) confirm earlier simulations by Calel (2012) that demonstrated cost-savings of joint bids if positive externalities between bidders exist and are sufficiently high to lower bid prices.

Spatially weighted auctions

Experimental studies have been widely applied to investigate the performance of different design features of spatially weighted auctions. Reeson et al. (2011) investigated the effect of not revealing the number of bidding rounds to participants. The authors found that keeping the number of rounds unknown improves the prices obtained, as farmers are incentivised to provide sincere proposals for their conservation costs from the beginning. Inflation of bids in earlier rounds in an attempt to achieve higher rents thus is prevented. Reeson et al. (2011) then locked the bids of provisional winners in later rounds. They showed that this effectively avoids artificial bid inflation of winning bids.

[5] For a detailed review of the experimental literature, please consult Schilizzi, 2017.

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Their experimental setup was refined in a later experiment by Krawczyk et al. (2016) to examine the effect of discriminatory pricing. In discriminatory pricing, each participant receives the payment requested in his or her bid. This is opposed to uniform pricing, where all winning bids receive the same payment amount that is determined by the highest winning bid. In their experiment, the discriminatory pricing rule is more cost-efficient than uniform pricing and allows the conservation of larger areas of land for the same budget (Krawczyk et al., 2016). This confirms results from earlier research. Though farmers bid more closely to their true opportunity costs in uniform price rules, auction efficiency is reduced under such rules by overcompensating all winning bids below the highest winning offer (Cason & Gangadharan, 2005; Duke et al., 2017).

Krawczyk et al. (2016) scrutinised the importance of communication *via* chat between subjects during bid formation. However, the authors did not find a significant impact of communication on auction performance. The authors suggest offsetting effects of improved coordination due to communication and the emergence of collusion and the inflation of bid prices for spatially valuable land parcels.

The influence of bidders' knowledge of the targeted spatial pattern in discriminatory weighted auctions was examined in a lab experiment by Banerjee et al. (2015). The authors found that the public disclosure of the spatial objective promotes rent-seeking but did not negatively impact auction efficiency. The authors explained this discrepancy with the higher probability of achieving the targeted spatial configuration and related conservation benefits if the target is known to participants.

On the issue of whether increasing experience improves auction outcomes, the existing literature is ambiguous. On the one hand, Banerjee et al. (2015) found that rent-seeking is aggravated with increasing experience of bidders, thus questioning the sustained efficiency of longer-term auctions with repeated funding and bidding rounds. On the other hand, Rolfe, Windle and McCosker (2009) report positive effects of conducting multiple bidding rounds in contexts where farmers are unfamiliar with environmental auctions or the supply of ecosystem services. The authors conducted field experiments and an actual auction in a rangeland area of Australia. Their findings suggest that particularly the initial bidding rounds can be highly valuable for farmers to elicit their private value of ecosystem service provision. Farmers used this first round to become familiar with the bidding procedure and learn about their market position. A potential explanation of the conflicting evidence is a converted U-shaped relationship between farmers' familiarity with the auction design and its efficiency. Thus, a minimum level of experience is necessary to ensure that farmers are able to bid according to their true opportunity costs. A too detailed knowledge about one's market power, however, likely promotes rent-seeking and collusive behaviour.

The general ability of spatially weighted conservation auctions to achieve spatial contiguity of enrolled land is demonstrated in a lab-in-the-field experiment with landholders and a lab experiment with student participants in Fooks et al. (2016). Their results indicate that landowners might perform better than students due to faster learning and familiarity with the choice situation. Finally, Windle et al. (2009) provide a real-world example of a spatially weighted conservation auction for biodiversity management in Australian rangelands. Besides the spatial targeting mechanism, the auction allows for joint bids of farmers and grants an uplift in bid scores if bids are submitted collectively. The authors demonstrate the success of this approach, with more than two-thirds of successful bids forming a distinct corridor with only small property gaps.

Joint bids in conservation auctions

With respect to the use of joint bids in conservation auctions, Rondeau et al. (2016) conducted an experimental auction with students that allowed for both individual and collective bids. In their experiment, joint bidding significantly improved cost-efficiency. The authors attribute this to the emergence of collusion between individual bidders in the experiment when joint bids were not allowed. While further experimental evidence on the use of joint bids is lacking, some empirical findings have been made in the context of piloting collective auction designs. As presented above in the context of collective contracts and group payments, Narloch et al. (2017) conduct a group auction with farmers in the Bolivian and Peruvian Andes. They demonstrate the general feasibility and cost-efficiency of joint bidding, particularly if collective action patterns are already established in the area and payments are made to the whole group instead of individuals. Another piloting auction in the context of irrigation water management in Japan confirmed tentative positive effects of allowing joint bids, including reductions of the auction's transaction costs. However, the auction administration heavily built upon pre-existing local capacity for collective action, *e.g.,* through the existence of formal and informal collective organisations and a tradition of collective irrigation management. Thus, the generalisability of outcomes to other contexts may be questioned. In line with this, another piloting auction targeting the reduction of nutrient runoff into Lake Erie in the USA did not trigger the submission of any group bids (Palm-Forster et al., 2016). In the study, this is linked to the higher effort of coordinating joint bids compared to individual bid formation (*ibid.*). This points to the importance of providing clear incentives for collective applications in conservation auctions. This can be done, for example, by combining joint bids with spatial scoring metrics that render collective bids more likely to receive funding.

5.2.3 Agglomeration or threshold bonuses

Collective contracts and allowing for joint bids in conservation auctions address farmers directly as a group. As such, they require joint efforts of the farmers to participate in a collective contract or submit a group bid. An alternative approach is presented by incorporating incentives for concerted scheme uptake within traditional AES designs open for individual farmers. A popular concept in that regard is agglomeration or threshold bonuses.

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As the name suggests, agglomeration or threshold bonuses are top-up payments granted additionally to a base payment if a defined spatial or collective objective is achieved (Kuhfuss et al., 2019). An agglomeration bonus (AB) is granted if farmers enrol parcels of land into a programme that are adjacent to other, already enrolled land areas (Parkhurst et al., 2002). Thus, the agglomeration bonus incentivises the conservation of contiguous land, required, for example, for the generation of habitat corridors.[6] By contrast, threshold bonuses (TB) do not target a specific spatial pattern of enrolment, but a defined general threshold of participation in an area, for contexts in which "the composition of the landscape matters but not its configuration" (Kuhfuss et al., 2019, p. 17). An example of an environmental objective that might benefit from a threshold bonus is the reduction of nutrient input into a lake. Here, a minimum reduction of fertiliser input in the lake catchment area is required, but the spatial configuration of enrolled plots does not matter.

Agglomeration bonus – experimental evidence

Proposed for the first time in 2002 in an experimental study by Parkhurst and colleagues as a mechanism to reunite fragmented habitats (Parkhurst et al., 2002), the agglomeration bonus has been subject to many experimental studies ever since. Even more, it found its way into broad-scale AES such as the Network Bonus Scheme in Switzerland. In their initial study in 2002, Parkhurst et al. find that the introduction of an agglomeration bonus is effective to enable contiguous habitat on a grid river catchment landscape.

Building on their initial experimental evidence, Parkhurst and Shogren (2007) then examined the performance of AB with communication in achieving different spatial conservation targets. They adapted AB requirements in their experiment to incentivise various spatial configurations such as stylised corridors, a block or cross habitat and multiple isolated habitats. Results indicate that participants were able to coordinate on the desired spatial patterns, even though time for learning is required if more complex spatial habitats are targeted.

Several studies unequivocally demonstrate the importance of communication for the success of AB schemes. First, Parkhurst et al. (2002) found in their initial experiment that the introduction of communication enables the highest probability of coordination success. Second, Warziniack et al. (2007) applied a similar experimental setup as Parkhurst and Shogren (2007) but vary treatments in regard to the possibility to send one message *per* round to the other players. Results show that players who were allowed to communicate achieve the conservation target sooner than players without communication. The authors hence suggest that communication might be particularly crucial when conservation actions are

[6] A reverse incentive, the agglomeration malus, also exists to promote the realisation of dispersed conservation areas. In contrast to the agglomeration bonus, it entails a reduction of scheme payments to farmers if their land lies adjacent to other enrolled land parcels (Bamière et al., 2013). Further, this incentive type can be adjusted to likewise reward the agglomeration of conserved land by reducing the payment amount if *no* adjacent farm also participates in the program.

irreversible, or regulators do not have time to allow for slowly approaching a conservation target. Third, Banerjee et al. (2017) focus on the effect of communication when participants differ in regard to their transaction cost of enrolment. They found that communication benefits AB participation generally, though the effect is particularly strong when transaction costs are high.

Banerjee and colleagues added to the experimental evidence with a number of studies, showing that achieving coordinated measures under an AB is harder when (i) network sizes increase (Banerjee et al., 2012), (ii) players are not informed about the choices of their neighbouring players (Banerjee et al., 2014), and (iii) transaction costs are high (or were high in the past) (Banerjee et al., 2017). In addition, the author investigated the potential of non-monetary nudges for AB schemes. Banerjee (2017) showed that players under an AB scheme react both to monetary incentives (*i.e.,* higher payments linked to coordination) and the non-pecuniary incentive of providing information on the coordination success of another community. The author thus suggested to use information nudges in conjunction with AB. However, the effectiveness of social nudges is put into question by experimental evidence reported by Kuhfuss et al. (2022). The authors conducted a student lab experiment with treatments varying in terms of whether an AB was included or not and the introduction of a group-comparison nudge. The nudge indicates a group's performance relative to the two other groups participating in the experiment at the same time (thus resembling the nudge examined by Banerjee (2017)). The authors found that while the AB alone is able to generate environmental benefits, combining it with a nudge does not significantly improve scheme performance. They suggest that providing information on relative group performance might promote more strategic behaviour of the poorly performing groups instead of inducing a social norm effect. Consequently, those groups converged to the risk dominant (and environmentally unfavourable) equilibrium. The authors concluded that more research is required to investigate the interactions of monetary and non-monetary incentives for promoting coordination in AB schemes.

More recent experimental studies attempt to add more realism to agglomeration bonus research and thus further increase their external validity. For example, Panchalingam et al. (2019) investigated the effects of endogenous and dynamic land values on the performance of an AB scheme in a laboratory context. Particularly, the authors incorporated positive spill-over effects of conservation measures on surrounding land parcels. These spill-over effects increased the productive value of surrounding land (*e.g.,* through pollination) and thereby increased opportunity costs if agricultural production on these parcels is forfeited. The authors argue that traditional experimental studies likely underestimate habitat fragmentation by not accounting for such endogenous land values. However, they demonstrate that this effect can be counterbalanced by applying a low-cost agglomeration bonus.

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Bareille et al. (2022) examined another aspect that likely diminish the performance of ABs outside of the lab or modelling frameworks. Traditionally, lab experiments and ecological-economic models assume full and unconditional cooperation of landholders in response to the introduction of an AB. However, land managers might refuse full cooperation if it is economically more viable, *e.g.,* in case of heterogeneous opportunity costs or extensive coordination costs. Consequently, patterns of partial coordination and more fragmented conservation outcomes would follow (Bareille et al., 2022). The authors examined the emergence of this phenomenon and potential consequences by use of an economic model within a coalition formation game. They found that assuming full cooperation of landholders when exposed to an AB scheme overestimates the cost effectiveness of AB schemes. The effectiveness of an AB appears to be higher for lower levels of public expenditure as with high levels of public funding spatial connectivity is achieved as a side effect of increasing participation rates. Additionally, effectiveness in the model is negatively linked with species dispersal rates and the spatial homogeneity of farmers' opportunity costs. More particularly, lower species dispersal rates and higher heterogeneity of opportunity costs increases the potential cost-effectiveness of an AB scheme in their study.

Finally, a further step out of the (student subject) lab and into the (lab-in-the-) field was made by Sheremet et al. (2018). The authors conducted a discrete choice experiment examining Finnish forest owners' preferences for programmes that mitigate the risk from invasive forest pests. They found that applying an agglomeration bonus in an experiment with the actual target population and framed around a realistic conservation decision puts the rather enthusiastic experimental evidence described above into perspective. In their study, the effect of introducing an AB appears to be highly dependent on contextual factors (*e.g.,* exposure to forest diseases in the past, expectation of future production risks) and landowners' attitudes towards local cooperation.

Agglomeration bonus – real world examples

Nevertheless, real-world applications of the AB generally demonstrate success in inducing spatially coordinated programme uptake. For example, Bell et al. (2018) investigated the effect of payments from hydropower producers to farmers for cultivating land cover vegetation against erosion in Malawi. The application of an AB in combination with a standard action-based subsidy without collective incentive resulted in a 170 % increase of conservation practices (no-till, mulching, or rotations) compared to the no-policy control group. However, the authors do not explicitly disentangle the effect of the standard subsidy from the AB, thus making it impossible to evaluate their relative contributions to the increased adoption rates.

The most prominent example of a real-world policy making use of AB is the Swiss Network Bonus programme launched in 2001. Participants are offered a top-up payment, the so-called network bonus, if they participate in network projects that improve the connectivity of local biodiversity conservation areas (Krämer & Wätzold, 2018). A first qualitative and exploratory investigation of the Swiss Network Bonus is provided by Krämer and Wätzold (2018). Results

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indicate that the Swiss AB led to increased adoption of the scheme (thus confirming the finding by Bell et al. (2018)) and the inclusion of more ecologically valuable areas. However, costs of the scheme are expected to be higher compared to an unconditional AES. Results from a regression analysis by Huber et al. (2021) corroborate the positive impact of the network bonus on habitat connectivity. Particularly, agricultural areas located at rather steep slopes and at some distance to the landholder's farm appear to be probable to be entered into the Swiss Network Bonus programme.

Threshold bonus – empirical evidence

The performance of threshold bonuses has been experimentally investigated mostly by use of discrete choice experiments. Kuhfuss et al. (2016) showed that a threshold bonus encourages wine growers in Southern France to enrol larger areas in an AES. The effect even exceeds what could be expected from the mere financial incentive of the payment, pointing towards the incorporation of a social norm effect. Vaissière et al. (2018) also found that bonus payments for the establishment of ecological networks increase farmers' willingness to accept a hypothetical scheme targeting biodiversity offsetting in the North of France.

One real-world application of the threshold bonus is presented in form of the Conservation Reserve Enhancement Program (CREP) in Oregon, USA. Participants receive a substantial one-time payment if 50 % of the landholders along a 5-mile stream stretch pledge to implement buffer strips to prevent soil erosion and nutrient runoff (A. W. Allen, 2005). Continued funding for CREP over the last two decades indicates scheme success and value for money for the American USDA, though no explicit investigation of the TB performance is known to the authors.

Summary

The reviewed literature points to a general potential for ABs and TBs to both promote AES participation and ensure the delivery of effective spatial configuration. Conversely to conservation auctions, communication has been found to be unequivocally beneficial for achieving spatial coordination under AB schemes. This is particularly relevant in the context of FRAMEwork farmer clusters. The clusters' established means for extensive communication and exchange between farmers suggest a potential for successful application of agglomeration incentives in this context. Other likely drivers for scheme success derived from the literature include small network sizes and transaction costs. And while knowledge of other farmers' pro-environmental behaviour can be expected to encourage participants to opt for collective action, research has also identified detrimental effects of full information disclosure when the strategic setup does not favour collective efforts. This calls for caution when using information nudges to promote spatial coordination.

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5.2.4 Agglomeration or threshold payments

Agglomeration or threshold payments take the idea of agglomeration and threshold bonuses even further. As discussed previously, agglomeration and threshold bonuses combine a base payment dependent on individual performance with a collective bonus. Agglomeration and threshold payments, however, link the full payment to coordinated collective efforts. Thus, agglomeration or threshold payments are only made "when an ecologically beneficial spatial configuration is generated" (Drechsler et al., 2010, p. 263). Following the definition presented before, agglomeration payments denote payments conditional on the simultaneous enrolment of adjacent plots of land, while threshold payments depend on the general level of scheme uptake in a target area. However, the published literature usually refers to the latter approach without differentiating the two terms (Drechsler et al., 2010).

Drechsler et al. (2010) investigated the performance of threshold payments conceptually by means of a simple mathematical model. The authors identified three interconnected mechanisms that determine the effectiveness of a threshold payment. First, positive ecological consequences arise due to the improved connectivity of habitats, i.e., the so-called *connectivity effect*. Second, scheme costs increase as relatively expensive land patches are enrolled to meet the spatial requirements of the threshold payment. The authors call this the *patch restriction effect.* The patch restriction effect is particularly high when cost heterogeneity of land patches is high. As has been shown in the previous sections, the patch restriction effect can be observed for any scheme that applies spatial targeting. Third and finally, farmers may decide to offer side-payments to other farmers whose participation in the scheme is necessary to meet the defined threshold of participation. If those farmers do not have an economic incentive to enrol due to high opportunity costs, a side-payment can, theoretically, be made to ensure that scheme requirements are fulfilled. This results in a so-called *surplus transfer effects*, as the overall producer surplus is reduced. The authors showed in an exemplary case study simulation that the three effects may enable cost savings of up to 70 % compared to spatially homogenous payments (Drechsler et al., 2010). However, no real-world implementations of side payments are documented as yet (Nguyen et al., 2022) and their acceptance by farmers and success in light of the substantial coordination effort required can be questioned.

Experimental evidence

Rudolf et al. (2022) compared the performance of an agglomeration payment scheme (conditional on a minimum level of enrolment of connected land parcels) with a threshold payment (conditional on a minimum level of enrolment without connectivity requirement) by use of a field experiment with oil palm farmers in Indonesia. Their results indicate a similar performance of both approaches in terms of participation rates and achieved connectivity levels. However, stricter requirements in the agglomeration payment programme led to more cases of coordination failure than in the threshold programme. Further, the authors demonstrate the linkage between communication and past coordination success. In their

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experiment, communication increases conservation outcomes in case of previous coordination success but has no effect in case of previous coordination failure. As already demonstrated for collective conditionality in group contracts, this points to a path-dependency of farmers' conservation behaviour under agglomeration payments.

Ferré et al. (2018) investigated whether agglomeration payments benefit from accounting for differences in opportunity costs between farmers as well as the development of opportunity costs across time. Against this objective, the authors conducted a computerised framed experiment with farm apprentices in Switzerland. They found that both approaches (constant payments and dynamic payments that reflect opportunity costs) induced environmentally-friendly farming. However, the constant payment was more environmentally- and cost-effective in their experiment than the dynamic counterpart. The authors suggested that the prospect of decreasing compensation payments (due to decreasing opportunity costs) disincentivises participants and impedes immediate coordination success. Additionally, they noted that constant payments might be more acceptable to inequality-averse group members.

Real world examples

A real-world implementation of an agglomeration payment is documented by Shimada (2020). The Kuma Joint Management Programme in Japan pays forest owners for transferring management rights over land parcels to a local agency that then implements joint management efforts on the enrolled lands. Based on spatial GIS data and a simulation-based estimator, the author finds a general positive influence of the agglomeration payment on forest conservation. Further empirical evidence is provided in a recent (not yet published) study by Limbach and Rozan (2022). The authors conducted an econometric analysis of farmers' participation in a programme targeting European hamster habitats in North-Eastern France. The programme offers payments to farmers if an area threshold of enrolment is achieved. Limbach and Rozan (*ibid.*) found that territorial characteristics of farmers' lands (particularly land size) as well as the existence of pioneering leaders promote participation in the collective scheme in their case study.

5.2.5 Combination and comparison of collective incentives

Given the variety of potential collective incentives to deliver spatial objectives in AES programmes, policymakers face the need to select an incentive type (or a combination of these) that can be expected to achieve the spatial target at hand and aligns with (i) farmers' knowledge of their own lands as well as neighbouring areas to disable information asymmetry, (ii) their capacity for collective action (*e.g.,* due to social links, previous collaboration and associated social capital) and (iii) their preferences regarding scheme designs that may include risky payments or high levels of conditionality. From a policymaker's view, research has aimed to facilitate this decision by theoretically comparing the

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performance of different collective incentives. For example, Wätzold and Drechsler (2014) demonstrate by means of a conceptual model that in terms of budget efficiency and cost-effectiveness an agglomeration bonus never outperforms both a homogeneous payment and an agglomeration payment. Instead, the authors found that the AB is always outperformed by one of the two incentives. From a conceptual point of view, this finding is valid and maybe even a bit self-evident. The AB presents a compromise of incentivising spatial coordination on the one hand while simultaneously providing an unconditional base payment to promote participation. AB thus eventually incentivise the enrolment of sub-optimal land parcels whereas the high conditionality of agglomeration payments always ensures that value for money is maximised. Nevertheless, and the authors recognise this caveat of their study, AB schemes can be advantageous as they present a lower barrier for enrolment and likely meet higher acceptance levels by farmers. The enrolment in highly conditional agglomeration payment schemes, on the other hand, can be expected to be less pronounced in similar contexts. In a later study, Drechsler (2017) complemented this examination of relative incentive performance. In his study, the author compared social welfare (defined as the difference of the monetised ecological benefit and farmers' conservation costs) and budget efficiency (defined as the difference between the ecological benefit and the conservation agency's budget) of threshold payments and conventional conservation auctions. By means of conceptual modelling, the author found that social welfare is maximised in conservation auctions because land parcels are targeted where conservation costs are relatively low. However, budget efficiency is enhanced in threshold payment schemes, probably due to the higher value for money if payments are conditional on agglomeration outcomes. It is important to note that the author did not assume a spatial targeting mechanism in the selection of bid offers. Thus, results might differ when an auction design is applied that likewise promotes spatial agglomeration.

Recent research also started to investigate the potential of combined collective incentives. This frequently entails the application of collective contracting in conservation auctions with joint bids, thus taking administrative advantage of the collective nature inherent to the bid application process (*e.g.,* see Narloch et al., 2017). Banerjee (2021), in a lab experiment with students, additionally scrutinised the application of agglomeration bonuses within auctions. She found that an individual AB does not enhance auction performance if joint bidding is also allowed. If, however, the AB is only granted for winning joint bids (and not for individual bid offers) ecological outcomes and spatial agglomeration can be aggravated in the experiment at the expense of higher costs. In her experiment, neighbouring farmers submitting joint bids were more likely to get funding as they entered lower joint bids in expectation of receiving the bonus payment. Liu et al. (2019) took this evidence to the field and confirmed that Chinese forest land owners lower their bids in anticipation of receiving the AB payment in a lab-in-the-field experiment. However, the authors did not find a significant effect on the resulting spatial pattern and point towards the relatively high share of participants showing apparent protest attitudes or misunderstanding of the experimental setup. Hence, the generalisability

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of experimental results to actual incentives targeting farmers or landowners may be questioned. Finally, Fooks et al. (2016) investigated the performance of AB payments and spatial targeting in an experimental auction setting. The authors found a potential synergy of the two mechanisms if bonus payments do not overly stretch the cost-efficiency of the scheme.

Overall, the theoretical, experimental, and empirical evidence points to the frequent success of collective incentives in boosting participation in AES, spatial coordination of enrolment and resulting environmental effectiveness. The cost-effectiveness of collective incentives requires further research, as the limited existing evidence demonstrates mixed results in that regard (Nguyen et al., 2022).

5.3 Result-based and collective schemes to support the Farmer Cluster approach

Interestingly, no AES currently applied within FRAMEwork piloting clusters include payments-for-results (or hybrid formats), nor a collective dimension in incentivising environmentally-sensitive farming. Moreover, the majority of cluster leads, and facilitators were not aware of these design innovations and their functioning. Exceptions to this are the English and Dutch cases where such schemes are, currently piloted, or already part of the national Rural Development Programme respectively. The question arises whether result-based or collective schemes might be able to deliver more distinct support for the cluster farmers to achieve their environmental goals.

The previous literature review has pointed to some aspects in which the cluster context predestines the application of result-based and collective schemes. With respect to result-based AES, the review has emphasised farmers' need for specialised training to cope with the diverse requirements of such schemes. This includes, for example, training for agro-ecological understanding, environmentally-sensitive farm management, and ecological monitoring. The cluster context allows to cost-efficiently deliver such extension services to a group of interested farmers. As such, workshops and training events are one of the most frequently reported activities within clusters in the UK (Adamson et al., 2020).[7] Furthermore, UK facilitators rate training as one of the most important factors enabling group success (Jones et al., 2020, p. 134). Thus, **the clusters' focus on delivering precise and bespoke training to their members is anticipated to be hugely beneficial for equipping farmers with the knowledge and skills needed for result-based AES**. Furthermore, the previous section has shown that delivering the environmental objectives of result-based AES frequently requires innovation and experimentation with new agro-ecological measures. Again, the cluster

[7] Note that this refers to the pre-existing farmer clusters in the UK (https://www.gov.uk/government/collections/countryside-stewardship-facilitation-funding, accessed 17 August 2022) and not the FRAMEwork piloting cluster in England.

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setting is anticipated to facilitate such efforts, as it promotes low-cost communication and exchange of farmers' experiences and lessons learned. Interestingly, other research has started to investigate the potential of result-based AES to be applied in the cluster context, as a recent masters' thesis study demonstrates (Sonntag, 2021). The study evaluates the applicability of result-based AES within the UK clusters based on qualitative interviews with facilitators. It tentatively confirms the potential of result-based schemes, as 80 % of the interviewed facilitators (*i.e.,* eight out of ten) would approve of the realisation of result-based payments within their clusters (*ibid.*).

With respect to the general feasibility of collective AES within farmer clusters, two aspects deem particularly relevant. First, several studies in the context of collective incentives point to the importance of path-dependencies determining groups' success in coordinating collective efforts. It was highlighted that coordination success is unlikely in the light of previous coordination failure, thus calling for **skilful facilitation to ensure effective collective action** from the beginning. In the context of farmer clusters, this supporting role is most likely embodied by the clusters' facilitator. In principle, farmer clusters are thus well equipped to ensure successful collective action early on. However, this rather positive prospect might clash with the reality of bottom-up and heterogenous farmer groups. Early experience with the FRAMEwork clusters has shown that both the farmers and the facilitators usually require time to develop and fill in their respective roles in their cluster. Thus, it might be overly optimistic to expect clusters to effectively coordinate collective action right from the beginning. At any rate, it may be said that the realisation of collective AES in the cluster context would further increase the importance of the facilitator. Second, the literature on collective AES demonstrates the crucial role of capacity for collective action to realise collective efforts. Particularly, this has been stressed with regards to communication. Here, again, farmer clusters might excel in providing farmers an easily accessible platform for open communication and exchange.

The previous section demonstrated that the feasibility and performance of innovative scheme designs is no easy consideration but determined by a range of aspects including (i) institutional capacity (*e.g.,* in terms of personnel and expertise required for mediating collaborative efforts or developing result indicators), (ii) farmers' attitudes such as risk aversion or preferences for collective action, (iii) collaborative path-dependencies and social capital, and (iv) the suitability of farmers environmental objectives for result-based remuneration or collective provision. A detailed assessment that does justice to these diverse determinants is neither possible nor intended within the scope of this report and based on the data available. However, the available literature and the data collected in the two surveys do allow for a tentative evaluation of the potential for result-based and collective schemes to align with the FRAMEwork clusters' environmental objectives. This may then be followed with a more hands-on consideration at a later stage. Against that objective, the following Table 3 and Table 4 collate information that is deemed relevant for examining the fit of result-based

(Table 3) or collective (Table 4) incentives for the piloting FRAMEwork clusters considered in this study.

Suitability of result-based AES in the cluster context

As for payments-for-results, Table 3 shows cluster-specific insights on a) whether or not result indicators and associated measurement protocols exist that have been implemented and evaluated so far to serve as guidance for developing suitable indicators to map the achievement of cluster objectives, and b) survey results on the degree of farmers' risk aversion. Regarding a), Underwood's (2014) collection of biodiversity-related indicators used in Europe serves as a reference. It is noted that the author did not cover more recent developments or indicators used outside of Europe. Overall, tested indicators promoting species richness on grassland are readily available and might thus suit the clusters in Austria, France, Italy, and Luxembourg. Though the presented indicator lists solely map characteristic plant species, Underwood (*ibid.*) presents evidence for a positive correlation between plant species diversity and insect biodiversity such as pollination (Albrecht et al., 2007) as well as pest regulation services (Balvanera et al., 2006). Underwood (*ibid.*) thus suggests that the indicators might also be considered if insects and natural pest control are the primary conservation targets. Further tested indicators are available concerning breeding birds on farmland that might inform the clusters in England, Estonia and the Netherlands, and biodiversity-promoting weed species on arable land that are anticipated to match the objectives documented for the English and Dutch clusters. As Underwood (2014) only covers biodiversity-related indicators, no result-based schemes are reported for the promotion of soil fertility and thus supporting the cluster objectives of the Czech and Dutch groups. However, the relatively easy measurability of soil characteristics suggests that a result-based remuneration of soil-enhancing practices might well be feasible. Finally, no result-based scheme is reported by Underwood (*ibid.*) to support small farmland mammals such as hares, mice and hedgehogs. This indicates that a newly designed approach might be needed to support that particular goal of the English cluster.

As a further indicator of the clusters' acceptance of a switch to result-based compensation payments, the before-survey elicited farmers' risk attitudes (last column in Table 3). As result-based payments incorporate the risk for farmers of not receiving compensation payments, risk-averse farmers can be anticipated to be less willing to participate in result-based schemes compared to conventional action-based AES. This concern has been confirmed experimentally (*e.g.,* Dörschner & Musshoff, 2015) and is corroborated by the fact that farmers have shown to be rather risk-averse (*e.g.,* Menapace et al., 2013; Reynaud & Couture, 2012). The cluster farmers' average risk attitudes as stated in the survey are presented in Table 3. It is striking that the cluster farmers generally indicate rather risk-taking attitudes, thus contradicting past research findings. These results may be aligned by pointing out two aspects. First, from a methodological point, the elicitation of farmers' risk preferences by means of a questionnaire might have induced farmers to express biased estimates of their actual preferences. This is

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supported by the fact that the elicitation process was not incentivised to reflect real risks in decision-making. Thus, more complex and sophisticated methods for risk elicitation such as multiple price lists might have resulted in more conservative risk measures (Charness et al., 2013). However, previous research demonstrates that the elicitation of risk preferences by means of surveys predicts actual behaviour in risky choices quite well (Dohmen et al., 2011). This suggests that another dynamic might be at play: it can also be imagined that a self-selection bias is present. Consequently, farmers who decide to participate in a pro-conservationist and collaborative farmer group may be more inclined to accept innovative and relatively risky production methods. Following this line of thought, farmer clusters might be particularly suited for the application of result-based AES. More data would be required to confirm such reasoning, but – to the best of our knowledge – the risk attitudes of farmers in the numerous existing UK clusters have not been investigated as yet. Overall, our findings suggest that the FRAMEwork clusters' environmental objectives might well fit a result-based remuneration. Cluster targets are usually reasonably easily measurable, reference indicators and monitoring protocols frequently exist to build upon previous result-based policies, and farmers' risk preferences indicate a high propensity to accept result-based payments.

Table 3. Factors determining FRAMEwork clusters potential to benefit from result-based AES.

Cluster	Environmental objectives	Pre-existing indicators and measurement protocols [a]	Farmers risk attitude [b]
Austria (AREC)	Plant and insect biodiversity	Mostly: Characteristic plant species for species-rich grassland for seven German federal states, France, and Switzerland	Rather risk neutral, but high heterogeneity
Czech Republic (CULS)	Protection of birds of prey Soil fertility (earthworms) Preventing erosion	Partly: Golden Eagle conservation in Finland	Risk-taking
England (GWCT)	Promotion of farmland birds Promotion of arable plants Pollinator and insect biodiversity Promotion of brown hare, harvest mice, and hedgehogs	Partly: Breeding birds on farmland in the Netherlands and Germany Arable weed species in piloting scheme in Germany	n/d
Estonia (EMU)	Bird protection Farmland biodiversity	Partly: Breeding birds on farmland in the Netherlands and Germany	Rather risk-taking
France (INRAE/GRAB)	Pest management (promotion of natural enemies: birds, bats, arthropod predators)	Partly: Characteristic plant species for species-rich grassland for seven German federal states, France, and Switzerland	Rather risk-taking
Italy (SSSA)	Pest management (promotion of spiders, carabids, parasitoid wasps)	Partly: Characteristic plant species for species-rich grassland for seven	Rather risk-taking

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Cluster	Environmental objectives	Pre-existing indicators and measurement protocols [a]	Farmers risk attitude [b]
		German federal states, France, and Switzerland	
Luxembourg (LIST)	Promotion of pollinators	Partly: Characteristic plant species for species-rich grassland for seven German federal states, France, and Switzerland	n/d
Netherlands (UVA)	Pest management Soil health (*e.g.,* earthworms) Promoting pollinators Promoting farmland birds	Partly: Arable weed species in piloting scheme in Germany	Risk-taking

[a] Availability of reference indicators as reviewed by Underwood (2014).
Color-coding: Most/Some/None cluster objectives are covered by pre-existing indicators and protocols: green/yellow/red.

[b] Measured as farmers' self-perception on a scale between 0 (not at all willing to take risks) to 10 (very much willing to take risks). A mean value of 5 indicates risk-neutrality, a mean-value of 6 is termed 'rather risk-taking' and a value of 7 or higher as 'risk-taking'.
Color-coding: Cluster is (rather) risk-taking / risk-neutral / risk-averse: green/yellow/red.

Suitability of collective AES in the cluster context

Turning now to the applicability of collective incentives within the FRAMEwork clusters, matters are complicated by the existence of multiple potential design adoptions to implement in AES. Collective efforts might be rewarded by using group contracts, allowing for joint bids in conservation auctions or incentivising spatial agglomeration with individual agglomeration bonuses or payments. As the previous chapter has demonstrated, each approach comes with its own merits and limitations and a one-fits-all solution is seldom acquired. Before this decision for or against a particular AES design is made, however, the potential for collective action to deliver cluster objectives can be considered more generally. Against that objective, Table 4 builds upon findings from Stallman (2011) to identify key ecosystem services (ES) that the reported cluster objectives target. The table further evaluates the services' potential for the collective provision by farmers based on a framework proposed by the author.

Stallman (*ibid.*) applies a qualitative framework to assess the suitability of ES for collective management by considering six characteristics of ES, that are:

1 the ES' potential for landscape-level enhancement (*i.e.,* whether or not a benefit generated collectively may also be achieved through individual efforts). In line with collective action theory, a high potential for landscape-level enhancement is assumed to increase the probability of collective action (*ibid.*). In contrast, an ES that can be provided adequately through individual efforts is unlikely to trigger collective management.

2 the ES' potential to deliver direct private benefits for the ES provider. These direct ES benefits to farmers might result from their application as input for agricultural production (*e.g.,* pollination) or manifest as cultural or social improvements (*e.g.,*

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aesthetic landscapes). Naturally, higher direct benefits are assumed to increase farmers' motivation to provide the respective ES.

3 the potential for indirect benefits, *i.e.,* benefits derived by delivering benefits to people other than the provider. These may include, for example, payments for flood control from downstream communities or hunting leases if the ES provider owns grounds featuring wildlife habitats.

4 the ES' potential to be bundled with the provision of other ES. This is motivated by many ES being interrelated and improving one necessarily also improves the other. Stallman (*ibid.*) provides the example of buffer strips along streams that not only improve water quality, but also enhance pollination, pest control, nature recreation, biodiversity, and multiple soil-related AES. ES' potential to be improved alongside other ES thus is assumed to improve the likelihood of that ES to be addressed through collective management.

5 the number of providers needed to enhance an ES. This, again, follows collective action theory. It is assumed that smaller groups more effectively organise collective action due to (i) lower transaction costs, (ii) a higher probability of individual providers to recognise the effect and value of their contribution, and (iii) a higher likelihood of face-to-face communication (Olson, 2009; Ostrom, 2009). Stallman (2011) thus argues that local ES (*e.g.,* pollination) are more likely to induce collective efforts than regional or global ES (*e.g.,* air purification).

6 the heterogeneity of ES providers required for ES delivery. Stallman (*ibid.*) follows the argument that collective action is less likely if it necessitates the involvement of diverse groups of political, agricultural, corporate, or academic actors. Thus, the management of water quality (likely involving farmers, factory owners, technicians, rural house-owners, …) is deemed less suited for collective action than, for example, orchard pest management (*ibid.*).

Stallman (*ibid.*) then merged the six characteristics into one overall suitability ranking ranging from 'highly suited' (for collective management) to 'not suited'. Her overall rating is based on a hierarchical ordering of the six characteristics presented above, *i.e.,* the characteristics 1-3 are considered more important in determining the ES suitability for collective management than characteristics 4-6. For details on how the individual ratings of the characteristics result in the different overall scores, please see Stallman (2011, p. 135f.).

Table 4. Factors determining FRAMEwork clusters potential to benefit from collective AES

Cluster	Environmental objectives	Associated ecosystem service (ES) [a]	ES suitability for collective mgmt [b]	Participation in collective organisations [c]
Austria (AREC)	Plant and insect biodiversity	Pollination Biodiversity	Highly suited Moderately suited	66 %
Czech Republic (CULS)	Protection of birds of prey Soil fertility (earthworms) Preventing erosion	Habitat provision Soil fertility Soil retention	Moderately suited Not suited Moderately to not suited	33 %
England (GWCT)	Promotion of farmland birds Promotion of arable plants Pollinator and insect biodiversity Promotion of brown hare, harvest mice, and hedgehogs	Habitat provision Biodiversity Pollination Habitat provision	Moderately suited Moderately suited Highly suited Moderately suited	n/d
Estonia (EMU)	Bird protection Farmland biodiversity	Habitat provision Biodiversity	Moderately suited Moderately suited	83 %
France (INRAE/GRAB)	Pest management (promotion of natural enemies: birds, bats, arthropod predators)	Pest control	Highly suited	100 %
Italy (SSSA)	Pest management (promotion of spiders, carabids, parasitoid wasps)	Pest control	Highly suited	63 %
Luxembourg (LIST)	Promotion of pollinators	Pollination	Highly suited	n/d
Netherlands (UVA/UVA)	Pest management Soil health (*e.g.,* earthworms) Promoting pollinators Promoting farmland birds	Pest control Soil fertility Pollination Habitat provision	Highly suited Not suited Highly suited Moderately suited	86 %

[a] *Following the classification of ecosystem services applied by Stallman (2011).*

[b] *Adopted from Stallman (2011).*
Color-coding: Majority of cluster objectives is highly/moderately/not suited for collective management: green/yellow/red.

[c] *Share of cluster farmers who indicated to be actively engaged in at least one initiative for collective action, such as professional cooperations, local production groups, business associations, neighbourhood committees, religious or spiritual groups, political groups or cultural groups.*
Color-coding: > 75 % / 51-75 % / < 50 % of cluster members have been engaged in collective organisations: green/yellow/red.

Stallman's (*ibid.*) evaluation of the ES targeted by the FRAMEwork clusters is presented in Table 4. It is worth noting that the ES required to deliver the clusters' environmental objectives are predominantly suited for collective provision, with a particularly high potential identified for pollination and natural pest control. The only exception are environmental objectives targeting soil fertility or retention. Both of these ES do not strongly benefit from a landscape-scale approach and might also be effectively delivered through individual efforts.

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Further, and following previous findings that collective efforts are more likely where general patterns of collective action are strong (Narloch et al., 2017), the before-survey elicited cluster farmers' previous engagement in collective action initiatives. These serve as an indicator for farmers' familiarity with collaborative approaches and potentially pre-existing social ties between the farmers in a cluster. The results are presented in the last column of Table 4 and show a rather heterogeneous engagement with collective initiatives across the clusters. High levels of engagement are apparent in the France, Estonian and Dutch groups with more than 80 % of the survey respondents indicating to be actively involved in at least one collective organisation. Moderate levels of about 60 % experience are reported for the Austrian and Italian clusters, whereas the Czech farmers are relatively inexperienced with the use of collective approaches (33 %). The Czech case points to potential challenges in realising a collective delivery of cluster targets. The group exhibits both relatively low levels of previous engagement with collective action and also an aim for enhancing the ecological status of cluster soils. However, the latter has not been found to be primarily impacted by landscape-scale management. The third objective of the Czech cluster, on the other hand, (*i.e.,* promoting populations of birds of prey) may well be effectively addressed *via* collective efforts given that habitats surely exceed the individual farm scale.

Promising collective AES designs for the cluster context

On the question which of the particular collective AES designs to choose for incentivising biodiversity-sensitive farming within FRAMEwork clusters, we argue to pay particular attention to the use of collective contracting, rather than auctions or agglomeration/threshold bonuses or payments. Several arguments may be brought forward that predestine the application of **group contracts** in a cluster context. First, group contracts make use of and benefit from the organisational structure already apparent in a cluster setting. No additional effort is required to set up or manage the groups to be contracted, and clusters have already established the structures needed for collective compliance with contract requirements (*e.g.*, regular meetings for collective decision-making and exchange). Thus, clusters' apparent ability to organise collective action may be effectively utilised and exploited by offering collective contracts to the groups, thereby lowering the scheme's transaction costs, and increasing budget efficiency. Second, the introduction of collective contracts is anticipated to present a relatively low administrative burden, as they fit well with the traditional action-based scheme design currently applied in the clusters' regions. No cluster leads or facilitators indicated knowledge or use of conservation auctions in the past. Thus, the implementation of such a novel contracting process is expected to require extensive capacity-building both on side of the environmental authorities and the participating farmers. And while the introduction of agglomeration bonuses or payments is presumably less demanding, it would still require the design of a novel incentive mechanism. Particularly, it would necessitate authorities to explicitly attach monetary values to connectivity (or, more generally, agglomeration) outcomes. On the other hand, existing individual AES may be relatively easily adapted for collective contracting by adding the requirement of group conditionality to the schemes. Third and deemed most important, collective contracts might prove particularly valuable in combination with result-based remuneration. As joint contracts allow the sharing of risk among a higher number of contractors, the risk faced by the individual farmer is reduced. This might thus address a key limitation associated with result-based AES. However, it must also be noted that collective conditionality might be perceived as risk-increasing by some farmers. This is due to the fact that it conditions scheme payments on the behaviour of others and thus a factor mostly outside of the control of the individual scheme participant. However, we expect this latter effect to be rather low if social cohesion and trust among group members is high. Thus, this might not be particularly relevant in well-functioning clusters. Nevertheless, more research is needed to confirm such reasoning and examine farmers reaction to a combination of result-based AES and collective contracts in the cluster context.

In contrast, **conservation auctions** are expected to work less smoothly in conjunction with result-based AES. Issues of low acceptance by farmers are anticipated, given that result-based conservation auctions would incorporate an additional dimension of risk in terms of the receipt of a conservation contract in the auction process. Furthermore, participants of a result-based auction are faced with the considerable challenge of deciding on the compensation payments required for the obtainment of the prescribed environmental results (instead of merely estimating costs for implementing a defined action). They would thus need to be aware of promising management actions and associated costs at the time of bid submission. This is even amplified if groups are to submit bids collectively, as substantial coordinative and cognitive effort is likely required to decide on realistic, yet competitive group bids. Overall, these practical challenges are argued to limit the feasibility of collective result-based conservation auctions.

With respect to **agglomeration and threshold bonuses or payments**, we assert a rather moderate potential for application in the cluster context. As has been elaborated in the previous sections, the primary aim of such incentives is to ensure the spatially coordinated uptake of AES contracts. These incentives thus aim to coordinate isolated measures of multiple farmers but usually do not require more active collaboration of groups of farmers.[8] We argue that, in the cluster context, spatially coordinated enrolment in AES may be achievable without explicit monetary incentivisation. This is due to the facilitator who usually takes on the role of coordinating individual AES applications of cluster members. In the UK, this coordinating task is one of the formally defined responsibilities of the clusters' facilitator (ADAS, 2018). A recent evaluation of the UK approach indeed showed that the connectivity of applied AES measures in the clusters' areas is frequently higher than for random spatial networks in the landscape (Jones et al., 2020). Thus, this empirical evidence suggests that the

[8] Once farmers have enrolled in an agglomeration/threshold bonus or payment scheme, scheme requirements are linked to individual efforts and do (usually) not require multiple farmers to actively meet, work together and maintain a dialogue (i.e., what Prager (2015) defines as 'collaboration').

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spatial coordination of AES enrolment can be delivered through the cluster approach without the application of monetary incentives. Nevertheless, clusters' success in spatially aligning AES options may be further improved by providing, for example, an agglomeration bonus. We thus suggest to consider the application of such incentives as an alternative if future research points to a rather limited potential of collective contracting for the cluster concept. However, as for now, we propose **collective contracting as an avenue for further research to combine concerted agri-environmental management with result-based remuneration.**

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5 Conclusion

This report demonstrates that the support provided for the FRAMEwork farmer clusters by utilising AES payments is highly heterogenous. Whereas in some clusters AES enrolment is the standard (*e.g.,* AREC), others make only scarce use of AES programmes due to lacking eligibility for AES funding or a paucity of AES programmes that fit the farming systems employed in the cluster (both have been observed for the Italian group). Hence, the cluster farmers' needs for AES funding vary. While conventional AES designs targeted to the cluster regions would present a considerable improvement in support for some groups, other clusters are calling for more sophisticated and innovative approaches that promote coordinated efforts on a landscape scale.

Two observations have been made regarding the alignment of reported cluster objectives and the schemes applied so far. First, most applied schemes promote environmentally sensitive farming practices in a rather general fashion (including organic farming) and are not targeted towards more narrowly defined environmental goals such as the promotion of particular species[9]. The most apparent exception to this observation is found in the Dutch case where farmers apply different AES that promote farmland birds. Opposed to this trend, the selected clusters tend to define their groups' environmental targets quite narrowly and tied to particular species or animal classes (*e.g.,* birds, rodents). It may thus be questioned whether the existing broadly designed AES are perceived as a valuable aid for the clusters' efforts. Though the available data does not allow to make unequivocal statements in this regard, it is reasonable to assume that the clusters would approve of AES that match their environmental goals more neatly. Second, the schemes used in the clusters frequently only support the delivery of a fraction of stated cluster goals. For example, the Dutch group applies a variety of AES targeting farmland birds, but entirely lacks funding to realise cluster goals linked to pest management, soil health and pollination. Given that no cluster leads, or facilitators indicated that a particular scheme to support cluster goals was missing, it is assumed that this limited use of AES is not linked to deficiencies in supply (*i.e.,* the AES available). Instead, we speculate limitations in farmers' capacity to administer enrolment in and compliance with several schemes simultaneously. Hence, it is hypothesised that farmers might be more likely to enrol in several AES at a time if the associated administrative effort was reduced. The innovative AES designs considered in this report might offer easement for the farmers in this regard. The literature suggests that both result-based AES and collective contracts are able to reduce the administrative burden posed to farmers. As for result-based schemes, farmers are not required to demonstrate compliance with a multitude of action-based measures but only need to show delivery of final outcomes. With respect to collective contracting, the pooling

[9] This is often referred to as a 'broad and shallow' approach, as opposed to AES that are 'narrow and deep' in targeting particular farming systems or species.

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of farmers in group contracts lessens the number of parties involved in contracting and the verification of scheme compliance.

On a more general note, the report has demonstrated the potential of result-based schemes to promote lasting behavioural and attitudinal change and improved conservation outcomes. Result-based AES are able to utilise local knowledge and put farmers in the role of 'producers' of environmental outcomes instead of mere 'followers' of prescribed management rules. However, the successful realisation of result-based AES hinges on the availability of appropriate indicators to measure farmers' performance, and their willingness to participate in a scheme that puts them at risk of not receiving compensation payments for their efforts. Concerning the former, the report has compiled lessons learned in the development and design of suitable indicators and pointed towards existing result-oriented programmes that might serve as a prototype for implementing new schemes in the cluster regions. With respect to farmers' risk preferences, survey data indicated that cluster farmers' risk attitudes are not in conflict with a result-based remuneration. This confirms the potential of result-based AES to benefit the FRAMEwork clusters.

Regarding the application of collective incentives within AES, the report shows that the majority of cluster goals and their associated ecosystem services would benefit from landscape-scale conservation *via* collective action. This highlights the importance of cross-farm management approaches such as the FRAMEwork cluster concept and calls for actively promoting this collective dimension in incentive systems such as agri-environmental schemes. Several possible means for collective incentives were reviewed and presented. A particularly promising one to support cluster objectives was identified in the form of collective contracting, possibly combined with group payments. Survey data indicates different levels of experience with collective approaches within the clusters. This suggests that some clusters might coordinate collective efforts with more ease than others as they can build upon pre-existing social capital and group capacity for collective action (*e.g.,* mediating decision-making processes, managing farmers' expectations). This does not mean that other groups are not suitable for collective efforts or the application of collective schemes, but just that more time might be required in some clusters to fully develop and benefit from the structures required for effective collective action.

Further research is needed to investigate farmers' reaction to AES that combine result-based payments with collective incentives. Particularly, previous reasoning that collective contracting might function as a risk-sharing mechanism for farmers and thus promote the acceptance of result-based AES would benefit from experimental examination. Furthermore, the realisation of collective contracts enables design considerations including the application of group payments. Groups could then apply endogenous distribution rules to consider farmers' actual contributions to the conservation goal or differences in farmers' opportunity costs. Experimental studies would be useful to investigate how group payments align with farmers' equality and fairness preferences. This would enable more nuanced policy recommendations for the design of effective AES in the context of the FRAMEwork System for Biodiversity Sensitive Farming.

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Appendix

A.1 Overview of agri-environmental schemes used in FRAMEwork piloting clusters

Cluster	Enrolment rate [a]	Scheme name	Targeted farming systems	Targeted ecosystem components	Overview of scheme requirements
Austria (AREC)	83 %	Organic farming ('Biologische Wirtschaftsweise (M11)')	Arable land	Plant and animal biodiversity	Compliance with EU organic farming regulations
		'Valuable Areas'-option within Nature Protection ('Naturschutz')	Arable land, grassland	Landscape structure, biodiversity, soil and water quality, climate protection	Prohibition of draining, mechanical stone removal, landscape corrections and mounds, fertilisation, sowing, and extensive utilisation of grassland
		Animal welfare - Pasture ('Tierschutz-Weide (M14)')	Livestock farming	Animal welfare	Pasture grazing on at least 120 days between April and November
Czech Republic (CULS)	83 %	Organic farming ('M11 Ekologické zemědělství (EZ)')	Arable land	Plant and animal biodiversity	Compliance with EU organic farming regulations
		Submeasure Bio Corridors ('Biopásy')	Arable land	Plant and animal biodiversity, soil quality, pollinators	Establishment of 'bio corridors' (*i.e.*, stretches of land left to fallow)
England (GWCT)	No data	'Countryside Stewardship'	Arable land, grassland	Biodiversity, pollinators, farmland birds	Various. For example, establishment of grass and wildflower margins, skylark plots, pollen and nectar plots, or restoration of species-rich grassland.
Estonia (EMU)	66 %	Environmentally friendly management ('Keskkonnasõbraliku majandamise toetus')	Arable land, grassland, fallow	Biodiversity and landscape diversity, pollinators	Environmentally friendly management, including diversification of crop cover, temporal crop rotation, growing of leguminous crops on parts of the lands, maintaining a winter cover of arable crops, participation in environmental management training and sound use of fertilisers and pesticide

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Cluster	Enrolment rate [a]	Scheme name	Targeted farming systems	Targeted ecosystem components	Overview of scheme requirements
		Regional Soil Protection ('Piirkondlik mullakaitse toetus')	Eroded and peat soils	Soil quality, climate protection	Maintenance of permanent grass cover to reduce erosion and nutrient leaching.
France (INRAE/GRAB)	60 %	No data			
Italy (SSSA)	50 %	No particularly valuable AES reported			
Luxembourg (LIST)	No data	Promotion of orchards ('Förderung von Streuobstwiesen')	Orchards	Biodiversity, pollinators	No mineral or organic fertiliser application or broad-scale herbicide use; maintenance of orchard by mowing or pasturing, pruning and replanting of trees, if necessary.
		Extensification of grassland (‚Extensivierung von Grünland')	Grassland	Water quality, climate protection	No use of plant protection products; no installation of new drainage systems; maintaining a winter cover (no pasturing during winter); maximum defined density of cattle (and associated manure); obligation to take part in an agri-environmental advisory session
Netherlands (UVA)	86 %	Herb-rich field margin ('Kruidenrijke akkerrand')	Arable land, grassland	Farmland birds	Establishment of herb-rich field borders to provide food, rest and breeding areas for field birds
		Skylark border ('Veldleeuwerikrand')	Arable land, grassland	Farmland birds (skylark)	Establishment of herb-rich field borders to provide food, rest and breeding areas for the skylark
		Winter food patch ('Wintervoedselakker')	Arable land	Farmland birds	Definition of crops to cultivate during winter; surface treatment and fertilisation are only allowed after consultation with the Collective
		Bird field ('Vogelakker')	Arable land	Farmland birds	Definition of crops to cultivate; restriction on the use of chemical weed control and fertiliser; management instructions regarding the timing of sowing, grubbing, mowing, and harvesting activities are set by Collective

[a] Proportion of farmers who participated in the 'Before'-survey (see Section 3.1) and were enrolled in AES at the time.

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A.2 Farmer 'Before'-Survey – Selected questions

G.1 How well would you say **are you informed about public incentives** (such as agri-environment and climate schemes) for environmentally friendly farming practices? Please use a scale from 1 (very poor) to 7 (very good).

G.2 Are you currently **enrolled in an agri-environment scheme**?

G.3 Are you farming under **organic certification**?

I.2 When you are deciding on the management of your farm, **who do you get advice from**?

- Family members
- Other farmers
- Government advisory service
- Private consultants
- Other:

J.1 Are you actively engaged in the activities of one of the following **initiatives for collective action**?

- Professional corporations (e.g. farmer's union)
- Local production groups (e.g. co-operatives)
- Business association
- Neighborhood committee
- Religious or spiritual group
- Political group (e.g. party)
- Cultural group (e.g. unions)
- None
- Other:

L.1 How do you personally assess yourself: **are you generally a risk-taking person or a risk-averse person**?

Please answer using the following scale, where the value 0 means 'not at all willing to take risks* and the value 10 means 'very much willing to take risks'.

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A.3 Survey of Cluster Leads and Facilitators – Part A

A. Information about existing public incentives

Agri-environmental schemes (AES) are governmental programs that are tied to pillar-2's rural development programs of the Common Agricultural Policy (CAP). They provide financial support to farmers for implementing agri-environmental measures on their land. Schemes may vary in the amount and types of measures offered and can be administered quite differently across the Member States of the EU.

An important task in the FRAMEwork project is to collect information on the AES available. We kindly ask for your support by telling us about AES available to the farmers in your pilot Cluster region. Please fill out the table on the following page. The following information is asked for in the respective columns:

AES name	What is the name of the Agri-Environmental Scheme?
Targeted farming systems	Which farming systems are addressed by the measures in the AES?
Targeted ecosystem components	At which ecosystem components or ecosystem services do the measures in the AES aim?
Complexity of measures	Does the AES include measures that are rather easy to implement or do they include more demanding measures, or both?
Measure type	Does the scheme pay on the basis of activities that need to be implemented or does it pay on the basis of ecological results obtained, or both?
Performance measure	If payments are made on the basis of results/outcomes, how are these results measured?
Allocation mechanism	How are AES agreements allocated? Are payments made to anyone who applies? Or are funds distributed a) in a 'first come, first served'-manner, b) competitively based on scores obtained (e.g. in terms of environmental value added), or c) via an auction (i.e. applicants submit bids specifying their compensation payments themselves)?
Funding length	What is the temporal scope of the agreements?

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Table 1: What AES are available in your pilot cluster region?

AES name	**Targeted farming systems** *(multiple answers possible)*	**Targeted ecosystem components** *(multiple answers possible)*	**Complexity of measures** *(multiple answers possible)*	**Measure type** *(multiple answers possible)*	**If result-based: Payments are based on …** *(multiple answers possible)*	**Agreements are allocated …**	**Funding length (e.g. "3 years")**	**Comments**
…	☐Grassland ☐Arable land ☐Permanent crops ☐Forests ☐Wetland/ponds ☐Field margins Other:	☐Species protection ☐Pollinators ☐Wildlife ☐Landscape structure ☐Biodiversity ☐Water quality ☐Soil quality ☐Erosion ☐Flood mitigation ☐Climate protection Other:	☐Rather easy to implement (entry-level measures) ☐Rather demanding to implement (higher-level measures)	☒Payments are made for activities adopted ☐Payments are made based on results obtained ☐ Payments are made on the basis of both activities adopted and results obtained	☐Results compared to some reference point (e.g. % increase in species richness or relative to others in the area) ☐ Absolute results (e.g. no. of indicator species found on the farm)	☐to anyone who applies ☐on "first come, first served" basis ☐based on scores obtained ☐via auction	No. of years	Please enter any other remarks that you would like to share
(please copy the row above if needed)	…	…	…	…	…	…	…	…

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1. **Do the AES available in your region promote collective enrollment (jointly by more than one farmer) in AES? Please specify by ticking the characteristics of collective AES below and providing the name(s) of the schemes in which they are implemented.**

	AES name(s)
☐ AES are open for group applications	
☐ AES payments are made to groups/collectives instead of individual farmers	
☐ AES payments are allocated via an auction* that allows for collective bids by groups of farmers	
☐ AES allocation promotes spatially coordinated applications (e.g. favoring the enrollment of connected parcels of land, granting an uplift in scores if farmers apply as a group, …)	
☐ AES offers a collective bonus (i.e. additional payment granted if a threshold of participation in the area is achieved)	
☐ Payment is conditional on a collective threshold (i.e. payments are **only** granted if a defined threshold of enrollment is achieved)	
☐ Other:	

***** Auction: Applicants are asked to submit bids that specify the compensation payments they would need to implement the scheme requirements.

2. **From your personal experience, are important schemes or measures missing? Which ones?**
3. **Which of the current schemes are particularly valuable for your Cluster, and why?**
4. **How are farmers' activities in response to AES (e.g. compliance with scheme prescriptions or the realisation of other scheme objectives) measured and evaluated in your Cluster's region? Does this measurement reflect and acknowledge farmers' efforts towards the scheme objectives? Is it effective in terms of time, quality and costs?**

(Please feel free to skip this question if you have no insight into how AES performance is measured in your Cluster's region.)

5. **Are you aware of any new schemes being planned or currently trialed? Could you briefly describe them and/or give a link to a website or public document?**

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