CALCULATING RESULT-BASED AGRI-ENVIRONMENT PAYMENTS – LEARNING FROM THE FRONT-RUNNERS

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Abstract
Result-based agri-environment payments (RBAPs) represent an innovative approach to incentivizing sustainable farming by linking payments to measurable environmental outcomes, such as biodiversity enhancement, water quality, and soil health. This paper explores the mechanisms used to calculate these payments across different countries, including Germany and Ireland, where result-based schemes are well-established. Drawing on design process analyses and case studies, the aim of the research is to investigates how payments are structured to reflect costs such as opportunity costs, management expenses, income forgone and transaction costs. Results indicate that while RBAPs offer flexibility and encourage farmer innovation, they also introduce complexity in payment calculation, requiring detailed cost assessments and robust monitoring systems. Despite these challenges, the schemes in these countries demonstrate the potential of result-based approaches to deliver targeted environmental benefits. The study concludes that successful RBAPs must balance fair compensation for farmers with effective incentive structures, while addressing risks and uncertainties associated with achieving ecological outcomes. This research provides valuable insights into the design and calculation of result-based payments.

Keywords: *result-based payments; payment calculations; agri-environment schemes; case studies*

Clasificare JEL: *Q14, Q18, Q20*

1. Introduction and context of the study

Agri-environment schemes (AESs) were established in 1985 as a way of compensating farmers for income forgone when implementing less intensive and more environmentally friendly agricultural management practices. In 1992, the AESs as a financial instrument of the Common Agricultural Policy (CAP) became mandatory for all European Union (EU) Member States, with each country developing its own programme. Farmer participation remains voluntary, although following the CAP reform in 2014, some practices were bound to the basic subsidy [1]. These schemes can be applied both horizontally (across the whole country), e.g. supporting organic farming, and zonally, within high nature value (HNV) areas [1, 2]. These include both cultivated land and uncultivated areas, such as wildflower strips [1]. With the launch of the Biodiversity Strategy 2030 as part of the European Green Deal and the new CAP (2023-2027), AESs play an essential role in the process towards sustainable food systems, biodiversity conservation and resilient ecosystems.

The majority of agri-environment payments in the EU are action-based payment schemes [3], which impose specific requirements on farmers for agricultural management. One of the main criticisms of traditional, action-based AESs is that their success is measured by the level of farmer participation rather than the achievement of actual environmental improvements [1, 4]. Their focus is limited in terms of tangible measurable outcomes and adaptation of practices that address the specific needs of farmers and their land. A way to overcome some of the limitations of action-based schemes is the integration of results-based schemes (RBSs) that link payments to specific ecological outcomes.

Result-based agri-environmental payments (RBAPs) are widely regarded as the future direction for the European agriculture. By their very nature and compared to payments for actions, agri-environment payments for results represent an innovative approach in agri-environment policy. RBSs have some distinctive advantages: firstly, they specify measurable results that help to build a direct link between payments and achieved environmental outcomes, such as biodiversity conservation and improvement, water and soil quality, or carbon sequestration [5, 6]. Secondly, RBSs encourage innovation by allowing farmers to choose how to achieve environmental objectives, rather than limiting them to specific actions. This approach can lead to more effective and context-specific solutions. Fewer restrictions and regulations make result-based payments more attractive to farmers [7]. Thirdly, results-oriented schemes have the potential to optimise costs, as funds are only spent when real environmental benefits are achieved [6].

Even though result-based AESs have gained popularity in the last decade with pilot on-farm projects launched in 2014-2015 by the European Commission (EC) in Ireland, Romania, Spain (Navarra) and the UK (England), they still have certain constraints. One of the most serious challenges for results-based AES is developing reliable indicators that accurately reflect environmental improvements [4]. These types of schemes are limited to cases where causal links between agricultural practices and environmental objectives are well established and can be represented by single or combined indicators. Some agro-ecological interactions are very complex, operate at specific spatial and time-scales and can vary even within small spaces and short distances [8]. Changes in habitats may respond slowly to changes in land management practices due to the slow-down of ecosystem processes and may not be captured by indicators for a long time. The time lag between management inputs and ecosystem management outcomes may also complicate monitoring and payment [8]. RBASs are associated with increased risk for farmers, as the outcome of land management practices may depend on factors beyond their control: farmers' behaviour on neighbouring land, weather conditions, etc. This requires effective risk management to be considered in the design of results-based payment programs. Lastly, the implementation of RBASs requires significant transaction and monitoring costs due to the need for reliable systems to verify outcomes. Therefore, such schemes are implemented in settings where monitoring costs are reasonably low [3].

In order to overcome the possible challenges associated with RBASs and their implementation for the delivery of higher quality biodiversity and improved ecosystem services on farmland, it's essential to consider the importance of well-designed result-based payments. Therefore, the current paper outlines some of the key steps that are required in the process of designing result-based payments, focusing on payments calculation. The process suggested in this paper is based on guidance handbooks prepared for the European Commission [9, 10].

The aim of the paper is to contribute to the knowledge and understanding of how result-based payments are structured to reflect costs such as opportunity costs, management expenses, income forgone and transaction costs in countries where these schemes have been well-established.

The results from this paper show that RBAPs are calculated based on the level of environmental outcomes achieved, typically measured by biodiversity indicators, habitat quality, or other ecological targets. Payments are structured to incentivize higher results, often through a tiered or sliding scale system, and are usually tied to measurable indicators such as species richness, habitat quality, or ecosystem services. Each scheme adapts its payment structure to local environmental and agricultural conditions, aiming to provide sufficient incentives for farmers to actively contribute to biodiversity and ecosystem conservation.

2. Methodology

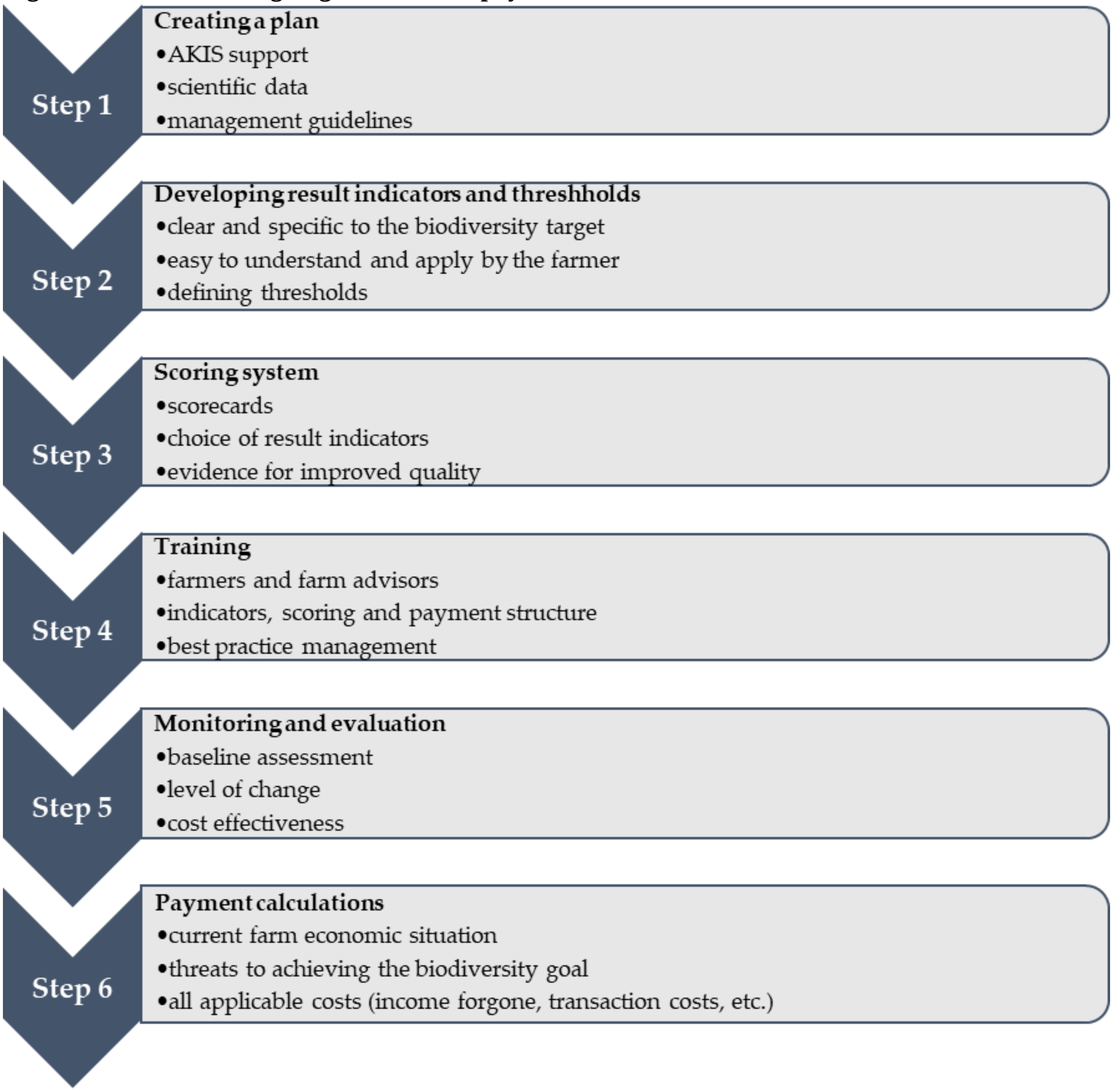
The methodology applied in the current paper is a literature review of peer-reviewed scientific articles, government reports and e-books. The selected scientific articles relate to European agri-environment schemes and result-based schemes. Government reports were analyzed to propose key steps in the process of designing result-based payments as a tool for enhanced understanding of payment calculation frameworks, including how factors like income foregone, opportunity costs and transaction costs are incorporated.

Based on the literature review, representative case studies from Germany and Ireland were selected. Selection criteria included availability of detailed data on payment mechanisms and implementation and longevity of the schemes.

2. Process of designing result-based payments

Effective implementation of result-based AESs depends on a clear and comprehensive process of designing of the payments that defines the ecological, economic and social parameters of the program. Figure 1 presents six key steps in the process of designing result-based payments.

Figure 1. Process of designing result-based payments



The first step in designing result-based payments involves creating a plan for the farmer and the farmland with the help and support of experts in agriculture and ecology. Result-based payments require qualified experts that can provide data on the condition of the habitat and the population of the species as well as list of all the fields that will be included in the scheme. Agricultural Knowledge and Innovation System (AKIS) is the system that connects researchers, farm advisors, farmers, organizations and other stakeholders with the goal of sharing knowledge, information and innovation. The role of farm advisors within the AKIS is particularly important, since they can help farmers with identifying the biodiversity targets and providing management guidelines.

The second and one of the most important steps in the process of designing result-based payments is developing clear and specific result indicators and defining the extent to which they are achieved (thresholds). To develop result indicators, it is essential to understand both the optimal condition for the biodiversity target and the agricultural practices that impact its quality. The result indicators need to be specific to the biodiversity target and easy to understand by the farmer. It is also important that they are in line with the existing on-line farming practices to guarantee farmer's participation. Payment thresholds are a key consideration in designing result-based schemes. On one hand result-oriented approaches create a stronger connection between provision and financial rewards, on the other - they are more vulnerable to environmental variations and tend to have higher management costs. Establishing the right number of thresholds is crucial to balancing effective incentives, maintaining payment stability, and controlling administrative expenses [6].

A comprehensive scoring system is the third step suggested in Figure 1. Scoring of the fields included in the scheme requires scorecards with choice of result indicators and checking for any completed actions. The score represents the degree of progress made toward achieving the specific objectives for the selected biodiversity target.

Training farmers and farm advisors (step four) to deliver RBASs is a critical component of ensuring their success. Effective training should cover understanding of result indicators, scoring and payment structure. Farmers need to be trained in systematic data recording and reporting, ensuring that their results can be validated for payment. Farm advisors should provide guidance on best practice management and adapting management strategies over time.

The next step in the process of designing result-based payments is the monitoring and evaluation. The first part of this step is conducting baseline assessments to determine the pre-existing environmental conditions on participating farms. This provides a reference point for evaluating progress. Baselines may involve biodiversity surveys, soil testing, or landscape assessments. Direct field-based monitoring is often the most reliable way to assess environmental results. This involves periodic site visits by ecologists and other experts to measure biodiversity indicators. Field monitoring can be time- and labor-intensive but provides high-quality data. Advances in technology have made it possible to monitor environmental changes more efficiently. Remote sensing via satellite imagery, drones, and geographic information systems (GIS) can be used to monitor vegetation cover, landscape changes, or habitat connectivity. These tools reduce the need for frequent field visits and allow for broader-scale monitoring. The primary evaluation metric is the degree to which the result-based scheme achieves its intended ecological outcomes. There should be evidence for a strong positive and significant relationship between the score and the measure. The success of the scheme is measured by comparing current conditions to both the baseline and established targets.

Evaluating the cost-effectiveness of RBAS involves analyzing the relationship between the financial investments (e.g., payments to farmers, monitoring costs) and the environmental outcomes achieved. Evaluation should also assess how effectively RBASs change farmers' attitudes and behavior. This includes measuring the level of farmers' engagement in the adoption of agro-ecological practices over time.

Beyond farm-level outcomes, evaluation should consider the impact of RBASs on broader environmental and agricultural policy goals (e.g., contributions to national biodiversity strategies or climate change mitigation efforts). This helps policymakers understand the value of RBAS as a tool for meeting global environmental targets.

The last step in the process suggested on figure 1 is calculation of result-based payments. Result-based payments are calculated based on the incurring of additional costs and income forgone as a result of the implementation of farming practices for the achievement of specific environmental or biodiversity outcomes [10]. Various costing mechanisms are used to calculate the total transaction costs, which form the basis for payments to farmers. However, public administration costs for managing the scheme are separate and not included in the payment calculation to the farmer.

Firstly, calculations of payments for results need to take into account the current economic situation of the farm, including threats to the achievement of the biodiversity target such as intensification, abandonment or land conversion [9]. Secondly, there are three main types of costs to be consider in the calculations. These are opportunity costs (determined by comparing the income generated from alternative land management options with the income earned from the current beneficial management practices); income forgone (determined by the change in management practices e.g. reducing fertilizer levels); and additional costs (expenses for carrying out practices for specific biodiversity results). Furthermore, there are transaction costs that need to be added to the payment calculation. Results-based schemes typically have higher transaction costs compared to management-based schemes because they require more time and responsibilities from farmers. Transaction costs are limited to 20 per cent of the maximum payment for schemes open to individuals, and 30 per cent for group schemes [10].

3. Payment calculations

The calculation of payments in RBASs involves multiple steps that ensure payments are fair, transparent, and effectively linked to the desired ecological results. Evidence from the literature [4, 6] highlights the importance of collecting baseline data to provide a reference point for measuring changes and improvements. This step is crucial for setting result indicators that are specific to the biodiversity target. There needs to a direct unambiguous link between the biodiversity targets and the result indicators as they serve as a proxy for achieving those objectives [8]. Indicators should be easily measurable and observable by farmers and should not depend significantly on external factors such as weather conditions. Burton & Schwarz [6] point out that both the ecological and economic success or failure of RBASs depend on the quality of the indicators.

Farmers often require training to understand biodiversity objectives and how to monitor environmental indicators. These include formal training, workshops, and ongoing advisory support. Providing advice and technical support throughout the scheme can be a significant cost, especially in regions where farmers lack prior experience in biodiversity-focused farming.

Since payments are tied to results, monitoring and evaluation are critical components of RBAPs. These include both the technical costs of assessing environmental outcomes by using expensive monitoring and measuring devices [4, 11] and the time farmers spend on reporting. In some schemes, farmers may monitor biodiversity indicators themselves, which requires additional training and time, thus increasing the monitoring costs. However, authors Villanueva et al. [11] point out that although monitoring costs represent a major challenge in the implementation of AES, involving farmers in the monitoring of the result or utilizing satellite-based control system can lower the monitoring costs.

RBAPs introduce risks to farmers because environmental outcomes may depend on external factors such as weather, pests, or other unpredictable events. The uncertainty of payment may result in farmers unwillingness to participate in such schemes [3]. As a result, payments must account for these uncertainties. Different authors [4, 12] concluded that the risk associated RBASs can be mitigated by combining an action-based scheme with a result-based scheme.

Important consideration in the calculations of agri-environment payments are the public and private transaction costs.

In analyses of the literature on transaction costs (TCs) authors Diaz et al. [13] concluded that agri-environmental schemes tend to incur higher administrative costs than other policies due to the extensive interaction required with farmers throughout the process, from negotiation to monitoring. They indicated that 70% of negotiation costs are borne by the public sector, while monitoring constitutes the largest TCs. In areas with fewer participants, per-contract costs rise due to fixed monitoring efforts. Same authors highlighted that TCs made up 38% of total costs in national agricultural programs. These costs were particularly high in management-based systems, which require more technical assistance than structural practices. Policies providing price support have the lowest TCs, while those focused on environmental amenities have the highest. AES designed to reduce negative agricultural impacts incur lower TCs than those aimed at stimulating positive externalities. Factors influencing public TCs include the number of agents, resistance to policy, required technology, and institutional arrangements. Experience with the schemes can reduce administrative costs over time. Involving farmers' organizations in AES design fosters trust and scheme uptake while also influencing public TCs. Overall, reducing TCs, particularly through improved information provision and agency-farmer interaction, remains a challenge at regional levels. Therefore TCs, which account for a significant portion of AES payments, should be closely considered in policy assessments.

A study by Mettepenningen et al. [14] found that TCs vary based on the type of farming activities adopted under agri-environment schemes, with private TCs accounting for 14% of total AES-related costs and 25% of compensation payments. They noted that some TCs are fixed, which may explain why larger farms are more likely to enroll in AES, as they can better absorb these costs. Small-scale farmers, on the other hand, face higher TCs, particularly in learning about programs, interacting with administrative staff, gathering information, completing paperwork, and record-keeping, especially when program requirements frequently change. Farmers with high TCs often participate less in professional networks and contract programs. Various factors influence private TCs, including the institutional environment, the type of AES, and the level of trust farmers have in the system. Whether specific investments are needed for AES also plays a role. Private TCs decrease when farmers have access to technical or financial advice, a higher educational level, prior experience with AES, or professional agricultural training. Mettepenningen et al. concluded that simplifying schemes, contracts, application processes, and monitoring mechanisms is key to reducing TCs and increasing AES participation among farmers.

4. Case studies

One of the longest running result-based schemes is the German MEKA programme ('Extensive Grassland Management'). MEKA-B4 was introduced in 2000 and co-funded by the CAP, focusing on species-rich grasslands in Baden-Württemberg and later in Lower Saxony. Under this scheme, farmers received payments if their meadows contained four of a list of 28 indicator plant species. In the years from 2000 to 2014, the scheme was hybrid and farmers received payments for results in addition to payments for extensive grassland management actions. Even though MEKA-B4 cannot be considered a pure result-based payment scheme, it can still account as a result-based scheme because the rules regarding record keeping of the application of fertilizers and grassland protection were not related to management activities [15]. In the 2014-2020 programming period, a two-tier 'stand-alone' payment was introduced, amounting to €230/ha for four indicator species and €260/ha for six indicator species, and the result-based measure could not be combined with other action-based measures, as it was before 2014. Over 9000 farmers participated in the programme covering an area of 66 112 ha.

The authors Russi et al. [15] point out that income foregone in the MEKA-B4 scheme was calculated based on reduced yield due to a reduction in mowing from three to two cuts per year and a 20% decrease in fodder nutrient content due to late mowing. The nutrient reduction was calculated by multiplying the energy loss by the market price of barley used for animal feed. Incurred costs for extensive grassland management included additional labor, as farmers needed to move the grass for three days to ensure proper drying, unlike silage, which can be produced in one day. Reduced input costs, such as a 25% decrease in fertilizer use and lower machinery usage, were also factored in [15].

In the programming period 2007 -2013 payments for intensive cattle farmers and biogas producers were too low and couldn't cover the opportunity costs [15].

Transaction costs have a significant role in result-based AES. These include the costs of designing, implementing, and monitoring the scheme. In the Baden-Württemberg case, transaction costs were incurred by both the public administration and farmers. Interviews with those involved in the design and implementation of MEKA-B4 indicated that transaction costs for administrative authorities were not significantly higher than those for action-based agri-environment measures [15]. This was partly due to the expertise of biodiversity specialists, who had an in-depth understanding of the botanical characteristics of the region. The only additional task for the paying agency was conducting field inspections between mid-May and mid-June, when most flowers bloom. Additional costs came from extension services, like assisted grassland inspections, where farmers learned to identify indicator species, though only about a third of farmers participated in these. Transaction costs for explaining MEKA-B4 and handling paperwork were minimal, as farmers were only required to fill in the application form. MEKA-B4 also bypassed costs associated with adjusting mowing dates, often required in other schemes. Overall, MEKA-B4's transaction costs were low and did not pose an obstacle to its design or uptake. [15].

One of the best designed AES for results is the Burren programme, (BP) which started in Ireland in 2005 with twenty pilot farms covering 2500 ha of priority habitats. In present days there are 328 participating farms covering an area of 23,000 ha. Over the last 10 years the programme has actively worked to protect and enhance cultural heritage and landscapes; sustainably managing high nature value farmland; and improving water quality and efficient water use in the Burren region. The programme has initiated a 5-year applied research project called 'BurrenLIFE' which is developing a plan for sustainable agriculture in the region. The BP applies a new "hybrid" approach, using two key interventions: Intervention 1 (I-1) is direct payments for achieved environmental results and Intervention 2 (I-2) to receive additional support by implementing activities (up to 5 activities within the contract and the allocated budget) to protect the environment [16]. The Burren programme does not take a holistic approach to farming: currently only species-rich areas are targeted, although Intervention 2 activities can also be carried out in species-poor areas to ensure better management of the targeted areas. The BP primarily focuses on improving field scores (I-1), with farmers encouraged to undertake additional conservation works (I-2) to achieve better results [16]. These capital works, which are non-productive investments, are crucial for improving field scores. While farmers receive recommendations for improving I-1 scores, the specific actions are decided by the farmer and their advisor (flexibility widely appreciated by most farmers). Up to five I-2 plans can be developed during a contract, with work done at the farmer's convenience before claiming payment. Between 2010-2016, only 56% of the I-2 budget was utilized [16]. The I-2 process involves planning by the farmer and advisor, with tasks mapped using GPS technology and then overlaid onto an ortho map. Each task is assigned a cost and included in a work plan that undergoes review by the BP team, which assesses environmental benefits, methodology, costs, and necessary permissions. The BP team also coordinates with relevant authorities to obtain required permissions, reducing the bureaucratic burden on the farmer. Once approved, the final plan is signed off by the farmer, and work can begin. Upon completion, the farmer submits the plan to the BP office, supplies receipts, and claims payment. The BP team and the paying authority of Department of Agriculture, Food and the Marine (DAFM) inspect I-2 works to ensure compliance, with payments processed promptly following approval [16].

Each farmer receives €100 per year for each hectare of Special Areas of Conservation (SAC) and additional habitat from a predetermined annex of selected habitats, including limestone pavements, orchid-rich calcareous grasslands, limestone heaths, scrub and woodlands, wet grasslands, turloughs, calcareous springs and fens. This means that for instance, a farmer with 40 hectares will spend up to €20,000 on I-2 works over a 5-year period. Each task in the I-2 work plan is assigned a cost using an annually updated menu, with scrub removal costs calculated using a specialized tool based on scrub area and methodology. Costs for wall repairs, access tracks, water provision, and equipment are based on local store prices plus labor costs. This system reduces the need for receipts, as site visits confirm task completion. I-2 works are co-funded based on their agricultural-environmental value: access tracks and cattle pens are funded at 25%, water provision and equipment at 50%, and wall repairs and scrub removal at 75%. This co-funding approach ensures careful task selection and rewards farmers who undertake more work. [16].

The success of the Burren programme is due to its tailor-made approach to local needs and specificities, the leading role of farmers, the innovative payment system and the strong spirit of partnership between stakeholders.

5. Conclusions

A key advantage of RBAPs is their potential to provide greater flexibility and autonomy to farmers, allowing them to use their knowledge and experience to achieve the desired ecological results in ways that best suit their local conditions. The design process of the payments involves defining clear environmental objectives, selecting appropriate and measurable indicators, assessing costs like income forgone, opportunity costs and transaction costs, and establishing a tiered payment structure to incentivize high-quality environmental outcomes.

In calculating payments, one of the primary considerations is the income foregone due to the adoption of less intensive agricultural practices. For example, in the MEKA-B4 scheme, payments were based on the reduction in yield and fodder quality from reducing the number of cuts and delaying mowing to support biodiversity. These direct economic losses must be carefully assessed and compensated to ensure that farmers do not bear the financial burden of delivering public environmental goods [15].

Transaction costs, including monitoring, administrative oversight, and the time farmers invest in understanding and meeting scheme requirements, can significantly affect the feasibility of RBAPs. While result-based schemes are generally perceived to have higher transaction costs than action-based schemes, the MEKA-B4 scheme shows that some administrative burdens cab be avoided by minimizing the need for frequent adjustments to management requirements, such as mowing dates, which are often necessary in action-based schemes. However, in some instances transaction costs remain a challenge. As pointed out by Herzon et al. [4] the high administrative costs of the Irish Burren programme can be seen as an obstacle to extending the scope of the scheme.

Another critical aspect in RBAPs is the design of payment thresholds. Result-based schemes are more susceptible to variations in environmental conditions, such as weather patterns, which may affect the achievement of the biodiversity target through no fault of the farmer. Thus, payment thresholds must be carefully calibrated to provide sufficient incentives while ensuring stability for farmers, even in the face of environmental variability. Too few thresholds may fail to capture the diversity of outcomes, while too many may increase complexity and administrative costs [14]. Striking the right balance is essential for maintaining farmer participation and ensuring the long-term success of the scheme.

A significant challenge in RBAP design is ensuring that payments are equitable across different farming systems and regions. Farmers in less favorable regions may face higher opportunity costs or struggle to meet ecological targets due to poorer soil or climatic conditions. Therefore, payment rates must be tailored to reflect regional variations in costs and potential income foregone. Additionally, ensuring that payments reflect the true value of the public goods provided, such as biodiversity conservation or water quality improvement, is essential for gaining societal support and justifying public expenditure on these schemes.

Currently, there is an extensive scientific literature on the design and payment calculation frameworks of well-established and longstanding result-based agri-environment schemes, however not a lot is known about the performance of schemes that were implemented more-recently. In order to better understand how RBAPs perform across multiple countries and regions that have significant social, economic and ecological differences and are at different stages of adaptation of these schemes, more research is needed in this direction.

The transition from action-based to result-based agri-environment schemes represents a significant shift in how agricultural sustainability is incentivized. While RBAPs offer the potential for more targeted and effective environmental outcomes, their success depends on accurately calculating payments that reflect both the ecological value and the economic costs to farmers. Careful consideration of income forgone, opportunity costs, transaction costs, and payment thresholds is essential to ensure that these schemes are both environmentally and economically sustainable. As more countries experiment with RBAPs, ongoing research and refinement of payment calculation methodologies will be crucial to their long-term success.

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